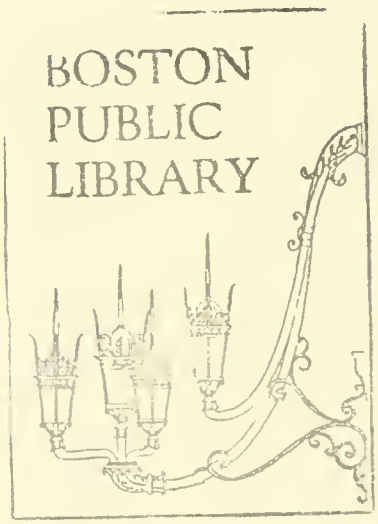
GOV DOC
BRA
1381

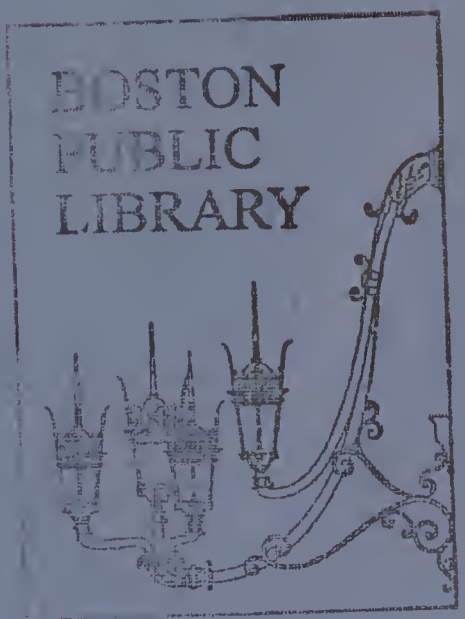

BOSTON
PUBLIC
LIBRARY

GOV DOC
B R A
1381

gov. 97-240

RESPONSES TO COMMENTS ON THE COPLEY PLACE FINAL EIR/EIS

BOSTON PUBLIC LIBRARY



Copley Place (Back Bay)
E88 H
R

H M M ASSOCIATES, INC.

RESPONSES TO COMMENTS
ON THE
COPLEY PLACE
FINAL EIR/EIS

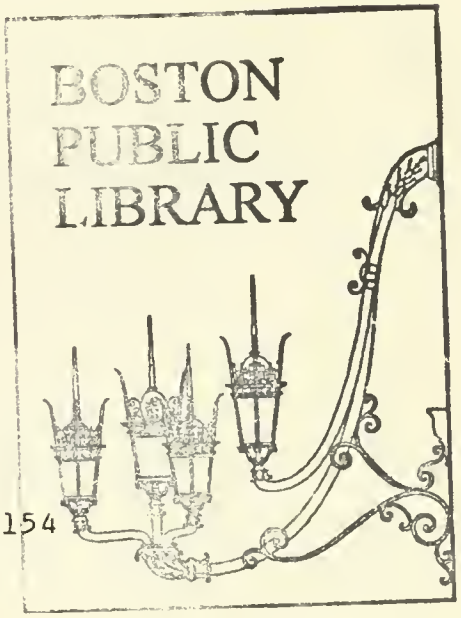
HMM Document No. 80-239

December, 1980

Prepared for:

URBAN INVESTMENT DEVELOPMENT COMPANY
200 Hancock Street
Boston, Massachusetts

BOSTON
PUBLIC
LIBRARY



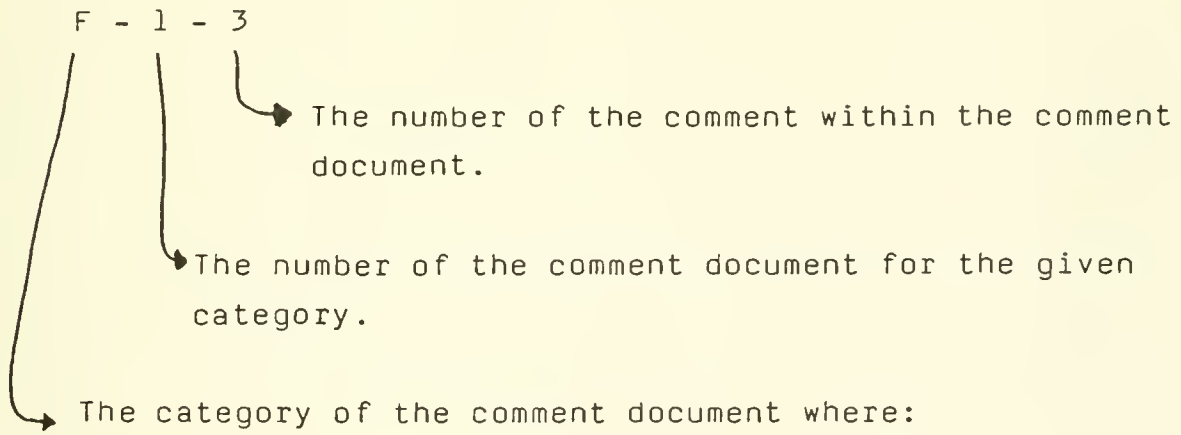
Prepared by:

HMM ASSOCIATES
255 Bear Hill Road
Waltham, Massachusetts 02154

1. INTRODUCTION

Responses to the comments on the Final EIR/EIS have been handled in the same manner that comments were handled within the Final EIR/EIS. This document contains a complete listing of the comments together with responses compiled by the authors of the Final EIR/EIS and UIDC. Each comment is identified by a letter/number identifier.

This section contains a complete listing of the comments received on the Draft EIR Supplement/Draft EIS together with responses compiled by the authors of that report. Each comment, and the corresponding response, is identified by a letter/number identifier.


F - 1 - 3
The number of the comment within the comment document.
The number of the comment document for the given category.
The category of the comment document where:
F = federal agency
S = state agency

The section begins with a complete listing of the comments and is followed by a listing of the responses in the same sequence.

The document first lists all the comments then the corresponding responses.

2. COMMENTS

INDEX OF COMMENTs

F-1	Environmental Protection Agency
F-2	Federal Highway Administration
S-1	Executive Office of Environmental Affairs
S-2	Massachusetts Bay Transportation Authority
S-3	Department of Environmental Quality Engineering
C-1	Boston Redevelopment Authority
C-2	Sherin and Logden
C-3	Carolyn A. Gritter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 0220

October 31, 1980

Mr. Richard B. Mertens
Environmental Review Officer
Boston Redevelopment Authority
Boston City Hall
One City Hall Square
Boston, MA 02201

F-1

RE: F-HUD-B89014-MA

Dear Mr. Mertens:

We have completed our review of the Final Environmental Impact Report/Final Environmental Impact Statement (EIS) for the Copley Place Development, Boston, Massachusetts.

EPA has reservations with respect to the impact of the Copley Place Project on carbon monoxide levels, and construction noise. While we do not object to the continuation of the project, we do submit the following comments for your consideration.

(1) The Final EIS appears to adequately address most of our air quality comments on the Draft EIS. However, we want to discuss the response to our first comment. The results of the analysis presented in the Draft EIS indicated that the expected concentrations for all options would be very close to the NAAQS at some receptors. The present EPA staff is not familiar with the models being used by the consultants in this study, nor do we know how they compare to the more commonly used and EPA approved Highway 2 and Caline 3. Therefore, we requested that the methodology be validated with the limited monitoring done for the project. In a meeting prior to submission of the Draft EIS, the consultant pointed out that they had previously met with representatives from EPA and Massachusetts Department of Environmental Quality Engineering to discuss the models to be used during initial stages of the project. We accepted this argument and allowed them to continue using their models. They are now using the same response with respect to our comment on validation, and argued that they should not be required to validate their model. We have reviewed our files and there is no record of what technical guidance was given during the early stages of this project. Thus, although we are still concerned about this issue, there does not seem to be a clear enough reason to object to the continuation of Copley Place Development at this time. We would caution that our review is based on the assumptions and methodologies used in the analysis. Since we do not have any data on the model, we cannot evaluate or judge the accuracy of the predicted ambient CO concentrations nor can we judge whether this project is likely to cause future year violations of the CO standard.

The Final EIS lacks a satisfactory answer to two of our noise comments on the Draft EIS. These two comments have been numbered 12 and 13 in the Final EIS. With respect to comment number 12, requesting that the topic of noise abatement for construction noise be addressed, the Final EIS response states that
(2) construction noise abatement was addressed in the Draft on page 7-145. We find no quantitative information in that section other than the questionable assumption that the Copley Place construction will make the same amount of noise as the Southwest Corridor construction. Although the Final EIS's response addresses some barrier effects, the response does not assess the noise impact in any greater detail. Concerning comment number 13, the response admits that Leq (24) and Ldn were computed arithmetically, not logarithmically. The response justifies this by claiming that "Log addition of the hourly Leq
(3) values would result in a 24-hour number greater than the peak hour Leq." Apparently our comment is not understood. Leq (24) is computed by dividing each hourly Leq by 10, computing the antilog and totaling the results which are then divided by 24. The logarithm of that result is taken and multiplied by 10 to give the final answer. In the Copley Place case, the Leq (24) and Ldn values are not severely distorted, but an error of this type causes one to question the validity of the other noise analyses.

We believe the final EIS should have responded to the detailed comments on noise impacts submitted by the Neighborhood Association of the Back Bay in their letter of December 6, 1978 to the Massachusetts Secretary of Environmental Affairs. Although this document was included in the comment section after letter C-1, the comments received no response.

Thank you for the opportunity to review and comment on the Copley Place Development Project.

Sincerely,

Richard R. Keppler

Richard R. Keppler, Acting Director
Environmental Impact Office

cc: Edward T. Martin, HUD
John A. Bewick, MEOEA

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION ONE
31 St. James Avenue-Room 211
Boston, Massachusetts 02116

F-2

Final Environmental Impact Statement
Copley Place, Boston, Massachusetts

IN REPLY REFER TO:
HEV-MA

October 14, 1980

Mr. Richard B. Mertens
Environmental Review Officer
Boston Redevelopment Authority
Boston City Hall
One City Hall Square
Boston, Massachusetts 02201

Dear Mr. Mertens:

Members of our staff have reviewed the subject Final Environmental Impact Statement. Apparently the only letter that your recieved from us was our comments on the pedestrian wind environment report. This letter was included in the FEIS and the comments were satisfactorily answered. However, there were two other letters that we sent to the Department of Public Works commenting on the draft EIS. Due to an error on our part, copies of these comments were never sent to you. Therefore, we are providing copies of these letters now for your information.

Thank you for the opportunity to review this document.

Sincerely yours,

N. J. Van Ness
Division Administrator

Edwin P. Holahan

By: Edwin P. Holahan, Assistant
Division Administrator

Enclosure

cc: Secretary John A. Bewick
Executive Offcie of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

FILE: 010 - Boston, Copley Place

100 Summer Street - Suite 1517
Boston, Massachusetts 02110

Copley Place Project

HEV-MA

July 9, 1980

Mr. Justin L. Radio
Chief Engineer
Department of Public Works
Boston, Massachusetts

Dear Mr. Radio:

Members of our staff have reviewed the subject Draft EIS. Our comments on this document are contained in our letter of May 19, 1980. The Department has already responded to Comment #1.

Thank you for the opportunity to review this Draft EIS.

Sincerely yours,

N. J. Van Ness
Division Administrator

EDWIN P. HOLAHAN

By: Edwin P. Holahan, Assistant
Division Administrator

cc: Mr. R. Horigan - DPW/Boston
Mr. J. Hurley - DPW/Boston
Mr. R. McDonagh - DPW/Boston

PDonovan/pamf

File

FILE: 010

100 Summer Street, Suite 1517
Boston, Massachusetts 02110

Subject: Boston - Copley Place
Basic Design Plans HA-MA

May 19, 1980

Mr. Justin L. Radlo
Chief Engineer
Department of Public Works
Boston, Massachusetts

Dear Mr. Radlo:

We have your submission dated March 10, 1980 concerning the Basic Design for the referenced project. A meeting was held on May 12, 1980 with members of your staff at which time our comments were discussed, as follows:

1. The proposed limits of the project and the extent of anticipated Federal-aid Highway Funding will be submitted for our review and approval.

2. The vertical geometry will be further evaluated in order to provide for a 30 MPH design speed. The geometrics, both vertical and horizontal, of Ramp "D" are substandard and should be further reviewed.

3. The proposed pedestrian crossing of Ramp "D" at Stuart Street has the potential to be very hazardous and accordingly should be eliminated. The crossing could be provided at the signalized intersection of Stuart and Dartmouth Streets.

4. At the intersection of Stuart and Dartmouth Streets, the north-bound approach has three lanes. We assume that the right lane will be for "Right Turn Only", since only two lanes are provided beyond the intersection.

5. The design criteria associated with the proposed roadway lighting should be submitted for our review. This criteria should include the justification for the type of light standard as well as the normal photometric data.

-more-

6. Safety-shaped barriers should be considered for use adjacent to Ramp "A" in order to realize optimum safety benefits.

7. The location of the proposed access from the service road in the proximity of the intersection should be further evaluated, since the present location may encourage some erratic movements.

Sincerely yours,

N. J. Van Ness
Division Administrator

By: C. L. Dunkley, Jr.
District Engineer

cc: Mr. F. Deleso - DPW - Boston

AALmeida/mc

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

S-1

EDWARD J. KING
GOVERNOR
JOHN A. BEWICK
SECRETARY

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS

ON

FINAL ENVIRONMENTAL IMPACT REPORT

PROJECT NAME: Copley Place, Boston

EOEA NUMBER: 03074

PROJECT PROPONENT: U.I.D.C.

DATE NOTICED IN MONITOR: September 22, 1980

The Secretary of Environmental Affairs herein issues a statement that the Final Environmental Impact Report submitted in the above-referenced project does adequately and properly comply with Massachusetts General Laws, Chapter 30, Section 62-62H inclusive, and the regulations implementing MEPA.

See attached comments.

October 30, 1980
DATE

John A. Bewick
JOHN A. BEWICK, SECRETARY

FORM E

Copley Place has the potential to offer numerous benefits to Boston. It will provide badly needed office and hotel space. In replacing a currently desolate, underutilized area with attractive and exciting forms of land use, it could serve as a stimulus to retail activities throughout the Back Bay. By linking adjacent residential neighborhoods to Back Bay retail and commercial areas it could enhance those neighborhoods.

Along with these and other far-reaching positive effects, Copley Place could also aggravate some of Boston's existing and potential problems. The extent to which Copley Place ultimately enhances the City depends upon several factors. Among them are:

- willingness of the developer to continue considering and responding to public concerns;

- implementation of steps described in the EIR/EIS to reduce negative impacts of the project;

- continued willingness on the part of the developer, in cooperation with the Boston Redevelopment Authority, to seek and evaluate additional project improvements and mitigation of project impacts as the design becomes final; and

- coordination and cooperation between the developer and other agencies to ensure achievement of goals and expectations in areas which are vital to the project but are not solely in the hands of the developer.

The BRA has on-going responsibility for design review and approval. From this point on, approvals and incorporation of measures to reduce detrimental impacts will rest to a large extent with the BRA, and while the EIR is determined to be adequate, the outcome of unresolved issues which will effect the environment must be left to the BRA, the developer and other agencies.

The cooperative response of many outside service agencies is also crucial to the successful functioning of Copley Place. Agreements must be reached for funding and design of important links such as the Southwest Corridor Deck, the underground connection to Back Bay Station and the pedestrian bridge to Prudential Center. Existing public facilities for water supply, sewage treatment and public transit are currently said to be not adequate to handle projected future demands, which will be significantly increased by the construction of Copley Place. Since Copley Place is not the only factor causing an excess of demand for these services over supply, they will need to be upgraded with or without the project. Copley Place could serve as an impetus to bring about the needed improvements.

The paragraphs which follow summarize measures proposed in the EIR/EIS to reduce environmental impacts of the project and recommend certain measures in addition to those discussed in the EIR/EIS. Where noted, comments require a specific response from the developer to the Executive Office of Environmental Affairs. All the mitigating measures should receive continuing attention from the developer and the BRA.

Measures to Mitigate Impact on the Environment Discussed in the Final EIR/EIS

Noise During Construction

1. Nighttime construction will be performed during the period of November-January when windows are apt to be closed at night.

2. Nighttime utility excavation is planned so that a single truck will move excavated material from the site of digging on Dartmouth to the triangular parcel bounded by Huntington Ave., Stuart St. and Dartmouth St.

3. The use of mufflers and of up-to-date equipment which generates lower noise levels can reduce noise during construction. Barrier effects of the new building facades will reduce noise exposure during later phases of construction. Noise reduction measures will be particularly important in areas near Gloucester Apartments and Harcourt Street residences, where predicted noise levels exceed the ceilings for construction site noise specified in City of Boston Regulation 3.

Traffic During Construction

1. The EIR states that curb lanes along the project's frontage on Huntington Avenue and Stuart Street may be needed for construction, and that the loss of those lanes for traffic may cause a reduction from level of service C to D. An effort should be made to keep the full width of Stuart Street at the Dartmouth Street intersection clear of construction vehicles and materials, and to provide a minimum of four lanes for a distance of about 200 feet from the intersection.

2. The hotel construction will necessitate occupancy of the Stuart Street curb lane along the luxury hotel site for construction purposes. If possible, this should be done while Stuart Street is closed (phase 2 of construction) when traffic volumes at the Stuart Street/Dartmouth Street intersection will be lower.

3. Scheduling of concrete mixing truck arrivals and structural steel deliveries should avoid peak traffic hours.

Employee Parking During Construction

The EIR enumerates measures which can be implemented to minimize the

impact of parking during construction by the several hundred construction workers, including: establishment and strict enforcement of a resident sticker program; carpooling and transit incentives; use of a portion of the construction site for parking, and use of the project's garages when completed, while the superstructure is being erected and finished; establishment of satellite parking in outlying areas with shuttle bus service to the site. The developer, and in the case of the resident sticker program the City, should ensure that these programs are implemented commensurate with the demand created by construction workers. The developer should designate an individual who shall be responsible for follow-through on this issue, and inform this office and the BRA of its selection.

Pedestrian Circulation During Construction

During construction it will be necessary to provide positive routing for pedestrians, clearly indicated and protected from hazards. Signalization may be needed to assist pedestrian crossing of the temporary detour road carrying Turnpike ramp traffic.

Air Quality During Construction

Measures which will be taken to minimize dust resulting from construction activities include:

- watering during periods of high winds;
- minimizing the period when spoils are stored at the construction site;
- locating aggregate storage piles away from sensitive receptors, such as the Harcourt St. residential area;
- monitoring of actual construction practices to ensure that unnecessary transfers and mechanical disturbances of loose material are minimized.

Wind

The Final Report on Pedestrian Wind Environment at Copley Place indicates that, of the 22 sensor locations studied for wind effects, 10 were made windier by the addition of the Copley Place project, 3 were rendered less windy by the project, 5 were not significantly changed by the project and 4 were not compared to existing conditions. The already windy existing conditions, coupled with increases and localized effects caused by the project, make it particularly important to ensure that virtually all possible measures to mitigate winds are implemented. Winds reach problematic levels at several key locations bordering the project: for example, at all corners of the Western International Hotel; at the Huntington Ave. entry to the Marriott Hotel; and along the Southwest Corridor Deck. Several mitigation measures are suggested in the point-by-

point discussion of each sensor location in Appendix D of the Final Wind Report. These include use of manmade and natural screening in several locations; careful attention to design detail of the pedestrian bridge to Prudential Center; a canopy along the facade of the Western International Hotel; and allowing pedestrians to use the underpass of the Marriott Hotel during high winds. The developer is appropriately seeking the cooperation of Prudential Center and should eventually enlist the cooperation of the Tent City project to jointly implement appropriate wind-reduction measures on their properties, which would, in turn, benefit users of Copley Place.

Findings of wind analyses completed subsequent to the filing of the Final EIR/EIS, as well as final decisions on measures which will be adopted to minimize wind impacts, should be supplied to this office when the information becomes available.

Energy

Efforts to minimize energy use have focussed on the selection of equipment and materials and on energy-conserving operating procedures. Energy conservation will be achieved by the use of double-pane glass in all windows; by the use of window systems which conserve energy by limiting infiltration and by discouraging improper window use by occupants; and by window blind systems designed to save energy. Energy-reducing operating procedures specified in the EIR include the use of outside air for cooling, placement of cooling towers in locations that will reduce pumping costs, flexible switching to allow tenants to turn out lights in unoccupied areas, and a lighting system which responds to lighting needs and is designed to take advantage of natural light. In addition, kitchen hoods will be supplied with unconditioned air from outside to reduce energy losses caused by exhausting conditioned air. Ventilation fans in the garage HVAC system will not operate constantly but will be activated by a sensor; and garages will be neither heated nor airconditioned. All equipment which will store or transmit hot or cold water will be insulated to save energy. In office buildings hot water will be heated to only 105 degrees which is substantially less than domestic hot water; in hotels, hot water heaters will be located close to users, using a zone concept, to minimize heat loss. Energy from building exhaust and from hotel laundry hot wastewater will be recovered and reused. These are some, not all, of the measures mentioned in the EIR to minimize energy use.

The EIR/EIS has not adequately examined the extent to which it will be possible to open certain windows or vents in the housing, hotel, office and retail elements of the project to permit individualized ventilation and cooling. Additional information on design of natural ventilation into the project should be furnished to this office.

Groundwater

To minimize potential draw-down of groundwater during construction of pile caps, three measures are suggested in the EIR/EIS.

1. Only 10 to 15 pile caps will be dewatered at any one time, in order to localize the effects.

2. Sheet piling may be placed around each excavation to inhibit inflow of groundwater.

3. Recharge wells may be positioned at the perimeter of the Copley Place site to maintain groundwater levels at surrounding structures, if observation wells indicate excessive lowering of groundwater levels.

Solid Waste

The volume of solid waste will be minimized by the use of compacting equipment.

Pedestrian Circulation During Operational Phase

The pedestrian signal planned for the crossing of Dartmouth St. at Stuart St. should be coordinated so that it does not interfere with traffic signal operations at either Stuart St. or Columbus Ave. Pedestrian volumes along Dartmouth St. near Back Bay Station are projected to be high (2,500-3,000 people per hour) and could, as the EIR/EIS indicates, produce sidewalk capacity problems. One cannot assume that all or most pedestrians will use the tunnel crossing, nor should they have to. Given the large numbers of pedestrians crossing during each crossing cycle and the resulting potential for congestion on sidewalks and street corners, optimal crossing conditions should be provided at ground level as well, by means of a mid-block pedestrian crossing signal on Dartmouth St. The signal if coordinated with those at Stuart St. and Columbus Ave., would not impede traffic flow along Dartmouth St.

Employee Parking During Operational Phase

To ensure that the calculated shortfall (estimated to be between 433-673 spaces) of the project does not become the problem of adjacent neighborhoods, it will be essential to carry out the commitments made by the developer and the City to reduce demand for vehicular access to the project by employees. The EIR has shown that in order for Copley Place to handle its own employee demand, over 75% of the employees will have to use public transit. Mitigation measures proposed which should help to achieve that level of transit use are: develop resident parking programs to protect the neighborhoods from all-day parking; develop a rate structure which will maximize use of the commercial spaces; and develop measures which can reduce single-occupant vehicle trips by employees, such as MBTA pass programs and preferential carpool parking.

Who will be responsible for developing and coordinating programs to attain the needed 75% transit use level by employees and for measuring results of those programs? The developer should maintain a continuing role in seeing that this is done, and should respond to this office on this point.

Measures to Mitigate Impact on the Environment Not Discussed in the EIR/EIS

1. Water Conservation

The imagination and ingenuity which went into the incorporation of energy-conserving features into the project design were not, unfortunately, directed toward water conservation. The statement of the Secretary of Environmental Affairs on the Supplemental Draft Environmental Impact Report acknowledged the inclusion of low volume shower heads and toilets, and asked the FEIR to discuss the feasibility of using other water conservation measures. The FEIR's response is that "no other conservation efforts have been studied". There are two important reasons why they should be studied. First, the ability of the MDC to meet projected demand for water supply is under review. Second, the ability of the MDC treatment facilities to accommodate projected sewage flows is uncertain. According to the EIR, Boston's 1990 water use is projected to be 11.5 mgd above safe yield; and whereas MDC's sewage treatment facilities are designed for an average flow of 343 mgd, the projected average flow for the year 2000 is 380 mgd. Clearly there is a need to conserve water in order to minimize the strain on both systems.

The EIR states that the Boston Water and Sewer Commission has not yet determined the adequacy of sewer service facilities for the project, and, further, that the hotel component will be the largest contributor to sewage discharge. The developer should investigate additional means to conserve water. For example, greywater reuse systems, involving recycling of sink, shower and laundry water for toilet flushing, can reduce water use by as much as 30 to 40%. A greywater reuse system of this type has been designed for a Marriott Hotel in Atlanta. It may be feasible to install such water recycling systems in the project's hotel and housing components. Further investigation of water conservation measures should be undertaken and the results submitted to this office.

2. Combined Effects of Concurrent Construction Projects

Except to state that the combined effect of construction of Copley Place and the MBTA's Southwest Corridor Project will be to increase noise levels by 3 dBA, little attention has been paid to the fact that construction work for Copley Place, the Southwest Corridor Project and Back Bay Station will take place simultaneously.

Although the noise effects of ventilation fans provided by Copley Place in the operational phase are evaluated in the EIR/EIS, their effects in combination with the ventilation fans to be provided as part of the Southwest Corridor Project are not known. Significant noise levels along the deck and Harcourt St. when both projects are operational could have a detrimental influence on pedestrian use and enjoyment of these areas. The

developer should discuss this problem closely with MBTA and get back to this office.

Pedestrian and vehicular routing during concurrent construction of Copley Place and the Southwest Corridor Project should receive further attention from the BRA and the proponent, in consultation with the MBTA. Issues to be resolved are the timing of construction of the Dartmouth Street bridge over the Southwest Corridor tracks and pedestrian access between a temporary West Canton St./Harcourt St. bridge and Huntington Ave.

Further attention should also be given to the coordination of construction activities which have the potential to affect the groundwater table.

3. Construction Noise

The developer should designate someone to be responsible for handling complaints and resolving construction-related problems.

4. Landscaping and Buffering

As detailed landscaping plans are developed, attention should be given to the provision of more effective screening and buffering of the pedestrian walkway along Harcourt St., to Huntington Ave. adjacent to the service driveway.

Moving the Marriott Hotel 14 feet toward the east, as recently proposed by the developer, offers an opportunity, through the use of heavy landscaping, to soften the impact of the hotel facade on pedestrians on Harcourt St. and St. Botolph St. This opportunity should not be missed.

5. Windows

Windows present an opportunity to provide links with adjacent neighborhoods and should therefore be incorporated wherever feasible. When decisions are reached concerning fenestration of currently blank walls, sketch plans should be submitted to this office. They should show the Southwest Corridor facade, the Mariott Hotel's Harcourt St. facade, the Stuart St. facade and the Nieman-Marcus facade along Dartmouth St.

6. Design Review Subcommittee

The UIDC/TAC response to the Design Review Subcommittee described in the Project Information Final Design dated October 2, 1980, addresses some of the concerns of the Subcommittee in a positive way. The Findings and

Recommendations of the DRS appear to be directed mainly toward making the project more compatible with its surroundings, providing increased linkage with adjacent neighborhoods, and creating a more humane pedestrian environment. These are highly desirable goals, and the recommendations should, to the extent possible, continue to be incorporated into the project design.

In summary, matters previously mentioned which require a response from the developer consist of:

1. information on operational noise levels along the Southwest Corridor Deck and Harcourt St. combined with operational noise that will be generated by the Southwest Corridor Project;
2. an update on wind analyses and mitigation measures proposed subsequent to completion of the final EIR/EIS;
3. results of investigation of additional water-conserving measures;
4. further information on the extent to which natural ventilation can be incorporated into the project design to conserve energy;
5. a description of fenestration and other treatment of currently blank facades;
6. the method and responsibility for dealing with problems and complaints during construction;
7. designation of an individual responsible for establishing and monitoring programs to minimize automobile use by employees.

Submission of these data and findings to the EOEA may be in the form of a letter.

Comments received during the public review of the Final EIR/EIS are appended.

John A. Bewick
Secretary

JAB:SU:cg

Attachments

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

S-2

Southwest Corridor Project
131 Clarendon Street, Boston, MA 02116
(617) 722-5834 (617) 522-6071

October 30, 1980

Mr. Richard B. Mertens
Environmental Review Officer
Boston Redevelopment Authority
City Hall
Boston, MA. 02201

Dear Mr. Mertens:

The MBTA, through its Southwest Corridor Development Office, has reviewed the Final Environmental Impact Report/Environmental Impact Statement for Copley Place, Boston, Massachusetts and have the following comments.

In reviewing the EIR/EIS we found that many of our previous comments on the EIR have not been addressed and are therefore still applicable. (I refer you to our letter "Review of Copley Place Draft Environmental Impact Report" of December 7, 1978 attached.) More specifically and to reiterate, in Section 4-1 under Project Funding the Developer mentions that UMTA funds will be pursued in connection with further improvements to the Southwest Corridor Project. This is in fact true, however, an appropriate cost sharing agreement has not yet been worked out between the Developer and the MBTA.

Clearly some of the items listed in the EIR fall within the responsibility of the Developer, and should have been included in this analysis.

1. Provisions for ventilating the Boston and Albany tracks - The Developer in the EIR/EIS claims that the cost of providing this will be added to the Southwest Corridor Project. The platform exist now and would have remained open to the elements, naturally ventilated, were it not for the Copley Place Project. The Development, therefore is responsible for providing and maintaining a well ventilated platform area for MBTA and Amtrak patrons, and will have to make provisions in his building for a shaft way, and all the associated mechanical equipment to ventilate the diesel fumes which will

(1)

accumlate in the area of the platform. The appropriate allowance should be made for an increase in commuter rail traffic which we have estimated to total as many as six (6) trains per hour in each direction in the peak period.

Emergency egress from this tunnel as well as from the Boston and Albany platform is necessary under the new fire and safety code. This too will have to pe provided for in the Copley Place development. (2)

Moving of the B & A tracks temporarily for the purpose of constructing the foundations for Copley Place will be required for this development. Train operations on the Boston and Albany tracks for MBTA Commuter, Amtrak and Back Bay to South Station Shuttle trains must be maintained at all times. The Boston and Albany line must accomodate a passenger station for Framingham/ Boston and Shuttle train passengers at all times. (3)

2. A direct pedestrian connection to the Mall area of their development - The pedestrian underpass from Back Bay Station under Dartmouth Street, to grade, was not originally a part of the Southwest Corridor Project. The underpass has been included in the designs for the station as a function of avoiding a mid block crossing from the Station to the Development, and to provide a direct link to Copley Place. The connection to the mall elevation would be the responsibility of the Developer in that it falls with his project boundaries. (4)

   The funding for providing the underpass and the stair, excalators and any roof enclosing the stairs at grade on the development side will have to be identified. At present there are important unresolved design considerations here.

3. Structural deck and landscaping over the tracks from Dartmouth Street to Yarmouth Street - Our comments in this regard of December 7, 1978, are still valid. A cost sharing agreement will have to be made, and the design for the Copley Place should encourage activity along this edge to insure the secutity of the Park that is to be built and the security of the abutting residential properties. Contrary to what the EIR says, the project, as (5)

(6) presently designed, turns its back on the Park and the South End neighborhood by creating large expanses of blank walls along the Southwest Corridor Deck, and providing little active frontage in this area. The Development does rely upon this deck heavily to satisfy its access and egress requirements.

(7) Furthermore the development proposes to locate the ventilation equipment from the Marriott garage and the Turnpike ramps in this vicinity. We are concerned about the noise being generated by these fans when combined with the ventilation shafts proposed for the Southwest Corridor Project. Their effect on the usability of the Parkland and the general nature of this area could be significant.

The EIR does not indicate what the noise levels of the fans are, particularly if they are tied to both the Marriott Hotel garage and the ramps from the Turnpike, now that traffic volumes on the ramps have doubled and the peak period for both of these may not coincide.

(8) The impacts and the coordination during construction may not be adequately addressed by the EIR. Construction of Copley Place must not interfere with the Construction of the Southwest Corridor. The contract packaging of the Southwest Corridor Project has caused certain revisions to our schedule which will affect the Copley Place Project. One area which is affected is the Dartmouth Bridge.

1. The EIR mentions that the construction of the Dartmouth Street Bridge by the SWCP will have been completed in early 1982. This has been revised, the street bridge will now begin construction in late 1982 and will be completed by the fall of 1983. This change will affect pedestrian and vehicular traffic detours for Copley Place.

2. The Boston and Albany track work cannot be completed by the Southwest Corridor Project as early as required to meet the EIR/EIS schedule. Temporary relocation of these tracks may have to be accompolished by Copley Place.

Coordination between the two projects will have to be worked out in order to maintain the existing water table and to monitor any settlement of properties which abutt both projects.

During construction a temporary bridge for pedestrian access will be built from across W. Canton Street to Harcourt Street. This bridge will be provided in place of the Braddock Park/Follen Street Bridge which will have to be removed. We expect therefore that pedestrian access across this bridge, to and from Huntington Avenue, will be maintained at all times.

(9) It is not clear whether the worst case of construction noise levels attributed to the Copley Place project include noise levels generated by the Southwest Corridor Project. The EIR says that the increase in noise including SWCP noise is only 3 dB's. At certain receptors this increase of 3 dB's will exceed the City of Boston's noise criteria. In these cases the EIR does not mention what mitigation measures will be utilized.

Sincerely,

Kenneth E. Kruckemeyer
Acting Manager
Southwest Corridor Development

DO/mdl

cc: R. Dempsey, MBTA
C. Steward, MBTA
J. O'Leary, EOTC

ANTHONY D. CORTESE, Sc.D.
Commissioner
727-5194

The Commonwealth of Massachusetts
Department of Environmental Quality Engineering
Metropolitan Boston - Northeast Region
323 New Boston Street, Woburn, MA 01801

S-3

RECEIVED
NOV 5 1980
OFFICE OF THE SECRETARY OF
ENVIRONMENTAL AFFAIRS

M E M O R A N D U M

RE: Copley Place E.I.S.

TO: Secretary, Executive Office of Environmental Affairs
ATTN: MEPA UNIT

FROM: Micheal J. Maher, Acting Section Chief, Air Pollution Control

DATE: November 3, 1980

Our agency has reviewed the final EIS/EIR submitted for the proposed Copley Place project. Since our office had already submitted a positive consistency determination on the draft EIS/EIR it was only necessary to scan the final for possible inconsistencies with the draft.

The following comments were made verbally to Ms. Sandy Uyterhoeven of your office:

1. Table 6.6-1 "Federal and Massachusetts Ambient Air Quality Standards", the 1 hour ozone standard expressed as 325ug/m^3 is incorrect, it should be 240 ug/m^3, page 6-62.

2. Section 7.6.6, page 7-131 "Dispersion of Carbon Monoxide from the Copley Place Vents", it should be demonstrated in the report why 11.3f.p.s. (3.4 m.p.s.) was considered to be the critical wind speed in assessing the potential for downwash in the analysis. A graphical or tabular format should be used in the report to demonstrate concentrations at wind speeds ranging from 3 to 10 m.p.s.

3. The wind speed at pedestrian height should be no greater than the wind speeds at stack height, thsi is not demonstrated in the report.

If you should have any further questions relative to the above, please contact Heidi O'Brien of this office.

Boston Redevelopment Authority

C-1

NOV 6 1980

Mr. Stephen F. Eimer
Associate Development Manager
Urban Investment and Development Company
John Hancock Tower
200 Clarendon Street
Boston, MA 02116

Dear Steve:

I am enclosing herewith all comments which were received by me concerning the Copley Place Final EIR/EIS during the Federal EIS review period.

It is HUD's policy that comments received on a Final EIS be responded to individually, by answering questions raised or providing the information requested. One purpose of this is to demonstrate that the agency has carefully reviewed the comments received in making its decision on the project.

Accordingly, I request that you and/or your consultants provide me with the specific information requested in the comments, as specified below, in order that I may respond to the commenters.

1. Environmental Protection Agency

   a. Information regarding air quality models used and validation of methodology (pg. 1, parag. 3).

   b. Information regarding construction noise abatement and 24-hour L_{eq} and L_{dn} calculations (pg. 2, parag. 1).

2. Federal Highway Administration

   No response needed.

3 Massachusetts Bay Transportation Authority

   a. Responses regarding comments relating to B&A track/platform (ventilation provisions, emergency egress, temporary moving of tracks) (pp. 1-2, #1).

   b. Responses regarding Back Bay Station/Mall pedestrian underpass (pg. 2, #2).

1 City Hall Square
Boston, Massachusetts 02201
(617) 722-4300
Boston Redevelopment Authority is an Equal Opportunity / Affirmative Action Employer

c. Responses regarding structural deck and landscaping, ventilation fans noise levels (pp. 2-3, #3).

d. Information regarding construction schedules (pg. 3, #1,2).

e. Information regarding construction noise and mitigation measures (pg. 4, parag. 2).

4. Sherin and Lodgen

Responses to concerns raised relating to property of Allen Realty, Inc. (25-35 Huntington Avenue).

5. Carolyn A. Gritter (Ellis Neighborhood Association)

Response to comments concerning CO dispersion from Copley Place vents (pg. 2, parag. 6).

I trust that this information can be provided in the near future. Please call me should you have any questions.

Sincerely,

Richard B. Mertens
Environmental Review Officer

S/211/F

cc: Scott McCandlass, HMM Assoc.
Jeff Chmura, BRA

PAUL MELROSE
MORTON B. BROWN*
GEORGE WALDSTEIN
IRVING SALLOWAY
ALETTE E. REED
ARTHUR S. WALOSTEIN
NEWTON H. LEVEE
STEPHEN H. CHASE
JOSHUA M. ALPER
NANCY LENORE CONLIN
THOMAS PAUL GORMAN

*ADMITTED IN FLA AND MASS

SHERIN AND LODGEN
COUNSELLORS AT LAW
140 FEDERAL STREET
BOSTON, MASSACHUSETTS 02110
TELEPHONE 426-5720
AREA CODE 617

ARTHUR L. SHERIN
1945-1964
GEORGE E. LODGEN
1945-1971

ALVIN LEVIN
OF COUNSEL

October 21, 1980

C-2

John Bewick
Executive Office of
Environmental Affairs
100 Cambridge Street
Boston, MA 02202

Re: Memorandum of Richard B. Mertens, Environmental Review Officer, Boston Redevelopment Authority, dated September 29, 1980 to Citzens Review Committee regarding Copley Place Final EIR/EIS

Dear Mr. Bewick:

Allen Realty, Inc. has instructed the undersigned to respond to the above-referenced memorandum.

As the owner of commercial premises located at 25 to 35 Huntington Avenue, Boston, Allen Realty, Inc. has the following comments to address to the Copley Place Final EIR/EIS:

(1) Construction of Copley Place will result in the loss of sunlight to the Huntington Avenue premises of Allen Realty, Inc. As a direct result of the loss of sunlight, Allen Realty, Inc. will incur substantially higher heating costs. In addition, the electrical utility expenses of the tenants of Allen Realty, Inc. will increase and Allen Realty, Inc. will therefore encounter difficulties in renting its commercial premises.

(2) Allen Realty, Inc.'s efforts to find new tenants and to maintain its existing tenants will be handicapped when the Copley Place project obstructs the open view presently available from its Huntington Avenue premises.

(3) Allen Realty, Inc. is greatly concerned that construction of Copley Place will cause structural and other types of damage to its buildings. The noise and vibrations of construction can result in broken and cracked windows, fractures in and disturbances to the foundation and harm to the building facade. In addition, construction

TO John Bewick

noise and vibrations will seriously interfere with the conduct of business of tenants of the Huntington Avenue premises and make it impossible for Allen Realty, Inc. to attract new tenants and fill vacancies left by tenants departing for the reasons cited above.

(4) The EIR/EIS fails to resolve the problem of assuring pedestrian access at the intersection of St. James, Dartmouth, Huntington and Blagden Streets. Although raised throughout the EIR/EIS, and therefore apparently recognized to be a problem created by the planned construction of Copley Place, pedestrian crossing at that intersection will be severely impeded by the juxtaposition of Copley Place with the Massachusetts Turnpike Authority tunnel. The result will be that the section of Huntington Avenue on which the Allen Realty, Inc. premises are located will be further isolated from community concourse, with concommitment economic loss to Allen Realty, Inc. and its tenants.

Your considerate attention to the concerns of Allen Realty, Inc. is appreciated.

Very truly yours,

SHERIN AND LODGEN
Attorneys for Allen Realty, Inc.

By: Morton B. Brown
Morton B. Brown

cc: Richard B. Mertens
Environmental Review Officer

Carolyn A. Gritter 52 Chandler Street Boston, MA 02116 542-5891

November 3, 1980

C-3

Mr. Richard B. Mertens
Environmental Review Officer
Boston Redevelopment Authority
Boston City Hall
One City Hall Square
Boston, MA 02201

Dear Mr. Mertens:

In re Final Environmental Impact Report/Environmental Impact Statement for the Copley Place development in Boston, Massachusetts.

Please consider the comments on the Final EIR/EIS submitted here by the Ellis Neighborhood Association prior to approval of the Copley Place project.

Report Section 7.1 LAND USE

Goals for the Copley Place project set forth by the Citizens' Review Committee (CRC) in the Final Recommendations, September 1977 have not been successfully met in several areas.

Though the project does cover the site, it does not reinforce adjacent block patterns since it fails to continue as pedestrian connections any of the streets which end at the site. The mall is an entirely new axis created to link the Neiman-Marcus store and the Prudential retail in typical suburban shopping center fashion.

The community retail space is supposed to relate the project to the South End and provide some active frontage along the Southwest Corridor Deck. However, the current development design provides only 8,000 square feet of community retail instead of the 15,000-20,000 square feet previously proposed. In addition, the back-door treatment of the neighborhood retail entrance was criticized by the Design Review Subcommittee (DRSC) in its report of September 24, 1980 as undermining the retail's chance for commercial success and its viability as a link to the surrounding commercial and residential neighborhoods.

The Southwest Corridor Deck is cited as a major transitional element between Copley Place and the South End. It should be stressed that this still unfunded landscaped deck is being constructed by the MBTA and is not part of the Copley Place project. What happens on the Southwest Corridor Deck is quite apart from the developer's responsibility to address the need for activity and linkage along the Southwest Corridor frontage of Copley Place.

Report Section 7.3.2 MASSING AND SCALE OF THE PROJECT ELEMENTS

Copley Place has increased from 3.12 million square feet to 3.43 million square feet, an increase of 310,000 square feet in size. This indicates a shift to a denser project with concomitant effects on the project design.

The height of the office block facing on the Southwest Corridor Deck is too great adjacent to South End housing and is an unacceptable transition to the low rise residential area. The facade and bulk of the Marriott tower along the Harcourt St. edge overpowers the adjoining residential St. Botolph neighborhood. Furthermore, the height of the housing is too great in relation to the St. Botolph neighborhood.

Because of the project's inward-oriented design, most of the commercial activity is invisible and only indirectly accessible. Activity is consistently directed away from the street. Along most of the project's edges, sidewalks are adjacent to massive inactive walls with few entries and exits.

Major emphasis is given to the retail mall as the principal pedestrian access through the project. While pedestrians are not forced to walk around the project, those who wish to do so are presented with numerous curb cuts along Huntington Ave., the absence of a sidewalk on the south side of Stuart St., and the pedestrian bridge to the Prudential as a substitute for an accessible ground-level crossing of Huntington Ave. The importance of the pedestrian environment is not satisfactorily addressed both in regard to active edges and pedestrian movement around the project.

Report Section 7.3.4 SHADOWS

It is most regrettable that Copley Square will be almost entirely covered by shadow from 2 PM until after 3 PM during the winter months. Use of this public open space as a place to sit in the winter sun is eliminated.

Report Section 7.4.8 PARKING SUPPLY AND DEMAND

Parking supply is reduced in the current plan in spite of an increase in some project elements. Copley Place is counting on long-term tightening of fuel supplies and new transit service to Back Bay to discourage parking demand. The admitted short-fall is a grave concern to the Ellis Neighborhood Association. All of the on-street parking in our neighborhood is occupied by residents and by commuters illegally parking all day. The need for a residential parking program both during construction and after is obvious. We urge the City's Traffic and Parking Department to honor its commitment to impacted neighborhoods and to implement a resident parking program before Copley Place construction begins. In addition, the developer should eliminate the impact of construction parkers by use of the construction site for parking.

Report Section 7.6.6 DISPERSION OF CARBON MONOXIDE FROM COPLEY PLACE VENTS

Drawings do not adequately show where ventilation leaves the building at Stack I along Stuart St. The concern about downwash is raised because sensors identify Stuart St. as a high-wind area. This combined with the canyon effect created by the new construction may reduce the rate of dispersion of pollutants in this area.

Richard B. Mertens
3.
November 3, 1980

Report Section 7.7 WIND

Serious pedestrian-level wind problems exist at points around the project: 1. along Huntington Ave., 2. at all corners of the triangle site, 3. at the Southwest Corridor Deck at Dartmouth St., and 4. at the south side of Stuart St. near the Massachusetts Turnpike exit ramp. Possible methods of mitigating the wind impacts caused by Copley Place are frequently of a Band-Aid nature (porous wind screens, awnings, and tree plantings) and in many cases, the solutions require treatment of areas outside of the project's limits; therefore not within the developer's responsibility. Two such examples include tree planting on the northwest side of Huntington Ave. and along St. James St. It is hoped that wind problems would be more satisfactorily ameliorated by changing building heights and orientations.

It is clear from the DRSC report and from the design agreement between the BRA and UIDC that unresolved design issues remain. The Ellis Neighborhood Association urges the establishment of a citizen advisory group to assist the BRA in resolving existing and future design issues.

Sincerely,

ELLIS NEIGHBORHOOD ASSOCIATION

by Carolyn A. Gritter
Carolyn A. Gritter, President

Enclosure

COPLEY PLACE
ELLIS AREA
BOSTON COMMON
PUBLIC GARDENS
Charles
STORROW DRIVE
BEACON STREET
MARLBOROUGH STREET
COMMONWEALTH AVENUE
BOYLSTON STREET
ARLINGTON STREET
CLARENDON STREET
DARTMOUTH STREET
EXETER STREET
FAIRFIELD STREET
HEREFORD STREET
GLOUCESTER STREET
MASSACHUSETTS AVENUE
NEWBURY STREET
BACK BAY FENS
PRUDENTIAL CENTER
NORTHEASTERN UNIVERSITY
ST BOTOLPH STREET
WESTLAND AVENUE
SYMPHONY ROAD
GAINSBOROUGH ST
HUNTINGTON AVENUE
MASSACHUSETTS TURNPIKE
CHARLESGATE E
CHARLESGATE W
IPSWICH STREET
DALTON STREET
HAVILAND ST
NORWAY ST
BURBANK ST
CLEARWAY ST
ST GERMAIN ST
SCOTIA ST
BELVIDERE ST
WESTLAND AVE
SAINT BOTOLPH
GAINSBOROUGH
ST STEPHEN
HEMENWAY
MUSEUM RD
ART MUSEUM
RUGGLES
COLUMBUS AVENUE
CAMDEN
NORTHAMPTON
WASHINGTON
TREMONT
SHAWMUT
BERKELEY
CLARENDON
DARTMOUTH
EXETER
FAIRFIELD
HEREFORD
GLOUCESTER
ARLINGTON
BOYLSTON
STUART
PROVIDENCE
ST JAMES
COPLEY PLACE
ISABELLA ST
CORTES ST
STANHOPE
DALTON
SCOTIA
BELVIDERE
ST GERMAIN
CLEARWAY
HAVILAND
NORWAY
BURBANK
WESTLAND
SYMPHONY
GAINSBOROUGH
ST STEPHEN
HEMENWAY
MUSEUM
RUGGLES
COLUMBUS
CAMDEN
NORTHAMPTON
WASHINGTON
TREMONT
SHAWMUT
BERKELEY
CLARENDON
DARTMOUTH
EXETER
FAIRFIELD
HEREFORD
GLOUCESTER
ARLINGTON
BOYLSTON
STUART
PROVIDENCE
ST JAMES
COPLEY PLACE
ISABELLA ST
CORTES ST
STANHOPE
DALTON
SCOTIA
BELVIDERE
ST GERMAIN
CLEARWAY
HAVILAND
NORWAY
BURBANK
WESTLAND
SYMPHONY
GAINSBOROUGH
ST STEPHEN
HEMENWAY
MUSEUM
RUGGLES
COLUMBUS
CAMDEN
NORTHAMPTON
WASHINGTON
TREMONT
SHAWMUT
BERKELEY

3. RESPONSES TO COMMENTS

It appears that current EPA reviewers have not been briefed on the process that led to the scope of air quality studies for Copley Place. The following is a brief outline of the course of events.

1) MEPA Scoping

Prior to the completion of the Draft EIR Supplement/Draft EIS, the Copley Place project entailed no federal involvement. Accordingly, the studies to be undertaken were negotiated through the Massachusetts (MEPA) scoping process. The MEPA scoping process was open to participation of all agencies and to the general public. EPA chose not to participate in this process. As a result, Massachusetts DEQE was the primary agency with whom air quality studies were negotiated.

During the scoping, the consultants to UIDC asked to be exempted from extensive air quality monitoring programs. The consultants explained that the project would so change the urban geography that monitoring data would be of little value in estimating future local pollutant concentrations. The consultants contended that the results of monitoring could not be used to validate model results and that modeling provides for a better "before and after" comparison. DEQE agreed, subject to several caveats: they wished to have presentations in which the models were explained and compared to EPA models, they wished to have the proposed modeling technique presented in advance of the modeling, and they wished to have limited spot-checks of existing CO levels in the absence of a reference method monitoring program. UIDC agreed to these conditions and scheduled a series of presentations at DEQE in order to obtain endorsement of the proposed studies.

At this time, an attorney for UIDC invited EPA to attend the presentations at DEQE. Mr. White of EPA declined the invitation. He explained, verbally, that EPA would defer to DEQE all authority for negotiating the scope of studies.

Subsequently, the consultant selected models, model locations, met conditions and traffic conditions to be used in the modeling exercise. Following the approval of the proposed study techniques and assumptions by DEQE, the consultants contacted EPA again. A meeting was scheduled with Mr. Whooley and Mr. Lee at the EPA offices. The study methods and assumptions were explained and a verbal expression of concurrence in the technique was expressed by the EPA representatives. EPA confirmed its approval of the studies by letter, dated September 20, 1979. A copy of that letter is attached to this response.

2) Validation of the Models

Throughout the scoping of air quality studies, the consultants explained, and the agencies confirmed, that no validation against on-site monitoring data would be done. Instead, the consultants provided data describing the air quality models and comparing the models to EPA models. This information is attached for EPA review.

It was also explained that both dispersion models have been used, and approved by EPA, for EIS efforts in various parts of the country. Both models were used on the Route 2 EIS, on the South Station EIS, for the I-93 EIS and for numerous other studies in Region I, for example. Both models have also been used in EPA Regions II, III and V as well.

If further information on these models is desired, EPA may contact Dr. Douglas Smith, of ERT, at 861-6400 to arrange a meeting to discuss the models.

American Institute of
Aeronautics and Astronautics
and
Public Technology Incorporated

COSPONSORS
American Institute of Chemical Engineers
American Society of Civil Engineers
American Society of Mechanical Engineers
Council of State Governments
Institute of Electrical and
Electronics Engineers
National Association of Counties
National Governors Conference
National League of Cities
National Society of Professional Engineers
U.S. Conference of Mayors

IN COOPERATION WITH
The City of Boston
International City Management Association

AIAA Paper
No. 73-972

HIGHWAY DESIGNS AND AIR POLLUTION POTENTIAL

by
BRUCE A. EGAN and THOMAS F. LAVERY
Environmental Research & Technology, Incorporated
Lexington, Massachusetts

3rd Urban Technology
Conference
and Technical Display

BOSTON, MASSACHUSETTS / SEPTEMBER 25-28, 1973

First publication rights reserved by American Institute of Aeronautics and Astronautics. 1290 Avenue of the Americas, New York, N. Y. 10019. Abstracts may be published without permission if credit is given to author and to AIAA. (Price: AIAA Member $1.50. Nonmember $2.00).

Note: This paper available at AIAA New York office for six months; thereafter, photoprint copies are available at photocopy prices from AIAA Library, 750 3rd Avenue, New York, New York 10017

HIGHWAY DESIGNS AND AIR POLLUTION POTENTIAL

Bruce A. Egan, Manager, Environmental Modeling
Thomas F. Lavery, Staff Meteorologist

Environmental Research & Technology, Inc.
429 Marrett Road, Lexington, Massachusetts 02173

Abstract

This paper presents the results of an extensive model development and validated study for the prediction of air pollution concentration levels in the vicinity of highways. A numerical advection-diffusion model is used to simulate contaminant flow strongly influenced by obstructions, topography, and spatially varying meteorological parameters. The numerical model is based on forward-time step, finite difference solutions to a conservation of pollutant mass equation applied to a grid system representation of the flow field of interest. The model validation and calibration utilized measurements from a six month monitoring program at six roadway locations in Washington, D.C. having different at-grade, viaduct, and cut-section design configurations.

I. Introduction

Automobile exhaust is known to be a very large contributor to poor air quality for certain pollutants on and near roads. The physical configuration of a highway can affect the magnitude of the air quality impact in a major way by its effect on the micrometeorological flow field and, hence, on the dispersion rates of vehicular emissions in the vicinity of the highway.

The proper assessment of the environmental impact of a proposed highway requires accurate predictions of the air quality in its environs. Detailed consideration of the highway design must therefore be included in the prediction technique.

Several atmospheric diffusion models have been developed to predict ambient pollution levels resulting from various emission sources. Most of these models are based upon multiple applications of a gaussian plume equation to calculate the pollutant concentration at a receptor. Gaussian - type models ignore spatial and temporal variations in meteorological conditions. They instead assume that the wind speed and dispersion parameters are uniform in both the vertical and horizontal directions.

These assumptions are not valid for the flow fields that exist very near to highways. The micrometeorological flow situation of importance to the dispersion of vehicular emissions is in fact characterized by the following factors:

1. Turbulent mixing rates are a strong function of height above ground - generally increasing with height.

2. Horizontal wind speeds generally increase with height.

3. Substantial initial mixing of vehicular emission occurs within the aerodynamics wake regions of the vehicle.

4. Significant spatial variations of the wind and diffusivity fields will occur as a result of obstructions to flow near elevated or depressed highway sections. Regions of systematic reverse eddy flow can generally be expected.

These factors suggest the abandonment of gaussian-plume type models for investigation of air quality near highways. Models based upon a conservation of pollutant mass equation and which can incorporate spatial variations of the advection and diffusion micrometeorological flow parameters are, in contrast, especially appropriate. The remainder of this paper describes the application of a numerical advection-diffusion simulation model based upon a conservation of mass equation to the prediction of carbon monoxide levels near six different roadways in the District of Columbia. Field observations of CO near the highway sites were compared to the model predictions to test the accuracy and reliability of the model.

The study results do indicate that such models are relevant in determining the air pollution potential of a particular highway design configuration.

II. Model Description

II.1 The Tracer Equation

The advection and diffusion of a pollutant are governed by the tracer equation. The two-dimensional equation, used in this study, describing the change of concentrations resulting from horizontal advection, vertical advection, vertical diffusion, and source emissions, is:

$$\frac{\partial \chi}{\partial t} = -U \frac{\partial \chi}{\partial x} - W \frac{\partial \chi}{\partial z} + \frac{\partial}{\partial z}\left(K \frac{\partial \chi}{\partial z}\right) + Q$$

where

- χ is the pollutant concentration
- U is the horizontal wind
- W is the vertical wind
- K is the turbulent diffusivity
- Q is the source emission

To simulate pollutant dispersion across and downwind of a highway, a vertical cross-sectional region enclosing the highway is divided into a number of grid elements. If the horizontal dimensions of the grid elements are set equal to the width of a road lane and the vertical dimensions equal to a mean initial mixing depth for the aerodynamic wake region of the vehicles, traffic in different lanes can then be represented by volume source emission rates in the corresponding grid elements.

II.2 The Computational Procedure

The model simulates the advection and diffusion of emissions from shallow-volume sources with a forward time step, finite difference algorithm. A major feature of the procedure is the suppression of "pseudo-diffusive" errors associated with conventional finite difference approximations to advective transport. This provides an important improvement in the accuracy of simulating pollutant transport numerically where spatial and time variations of winds and diffusivities are of major importance, e.g., near highways.

The material-conserving computation procedure involves iterations of the zeroth, first and second moments of the concentration distribution within each grid element with time. The scheme fundamentally conserves pollutant material and descriptive statistics of the material distribution. The theoretical basis for the model is described in Egan and Mahoney,[1],[2].

Procedurally, the model first calculates the wind and diffusivity fields based on simple power law relationships and fundamental conservation equations of fluid mechanics. The model then applies these fields to the numerical simulation procedure defined by the finite-differenced tracer equation and the two-dimensional grid system.

II.3 Calculating the Wind Field and Diffusivites

II.3.1 Horizontal and Vertical Winds

Both the horizontal, U(x,z), and vertical, W(x,z), winds are calcualted on the basis of conservation of mass and according to the "topography" in the grid system. A simple power law expression for U is assumed at the left boundary, i.e.,

$$U(0,z) = U_1 \ (z/z_1)^{\alpha}$$

where

α depends on atmospheric stability

U_1 is a measured wind speed

and

z_1 is the height at which U_1 is measured.

For computational purposes the wind direction is always perpendicular to the highway. To simulate winds at small azimuth angles (θ) from the normal, the model reduces the wind speed in the advection terms by a factor cos θ, simulating an increase in travel time of pollutants to corresponding positions normal to the roadway.

The wind fields for different roadway configurations - at-grade, elevated, and depressed - are calculated by assuming that various horizontal velocity profile modifications will result from the presence of obstacles and by requiring that the wind fields that result satisfy conservation of mass at each grid element. Vertical winds are calculated assuming simple continuity, i.e.,

$$\frac{\partial U}{\partial x} + \frac{\partial W}{\partial z} = 0,$$

with an upper boundary condition that requires W to vanish at the top of the system. A relaxation scheme was developed to insure mass conservation after calculation of the vertical velocities.

II.3.3 Turbulent Diffusivities

The estimation of turbulent diffusion rates near the ground as a function of atmospheric conditions, height and local topographic features remains a major research topic in micrometeorology. The diffusivities used in the model are based on empirical data[3] and results inferred from the measurement program.

Over level terrain the diffusion coefficients, K(x,z), are considered to be a power function of height of the form

$$K(z) = A(z/z_1)^B$$

where

A and B are functions of wind speed and atmospheric stability conditions.

Various roadway configurations alter this basic field. The diffusivities are simply modified on the lee side of obstructions and vanish at all boundaries.

Figure 1 shows the form of the wind and diffusivity fields expected for a typical depressed highway section. The flow reversal shown in the $U_2(z)$ velocity profile and the areas of modified mixing rates parameterize turbulent eddies found on the lee side of obstructions[4]. These model features are important specific elements in determining air quality levels in areas with complex micrometeorological characteristics.

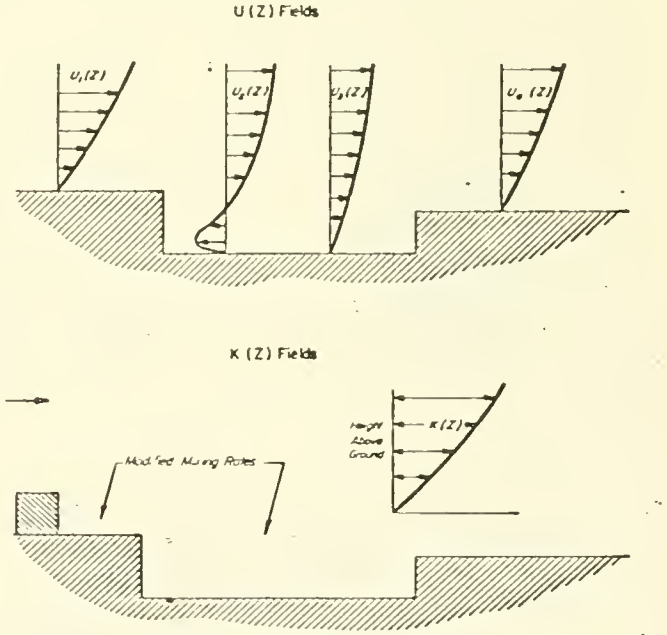


Figure 1. Velocity and Diffusivity Profiles Expected in the Neighborhood of a Depressed Highway Section

III. Model Application and Validation

Vehicular emissions on roadways are simulated by simply specifying a volume source emission rate

in a particular grid element representing a highway lane. This emission is specified as uniformly mixed throughout the grid element.

Figure 2 presents the concentration field calculated with the model for a depressed highway section. The high concentration levels along the upwind section of the cut result from a reverse eddy similar to that shown in Figure 1. Figure 3 shows the relative impact of an at-grade vs. an elevated highway upwind of a bluff. The flow field is distorted by the presence of the decelerating horizontal wind speed below the bluff and a large upflow over the bluff. The reduced velocity and turbulent mixing rates near the low-level road cause it to have nearly five times the concentration impact per unit traffic volume.

roadway. Continuous sampling of carbon monoxide was conducted by sensors mounted at three different elevations for each trailer. This geometry was chosen so that 'background' contributions upwind of the roadway could be identified and accounted for in the model validation. The roadway contribution to air quality could then be identified as the differences between the measurements at the downwind station and the background values. Measurements were made at three different heights (3 ft, 15 ft, and 30 ft) on each side of the roadway in order to quantify the variations of pollutant concentration with height.

Source emissions derived from measured traffic volumes and using the latest EPA emission factors[5], wind speeds and directions, and atmospheric

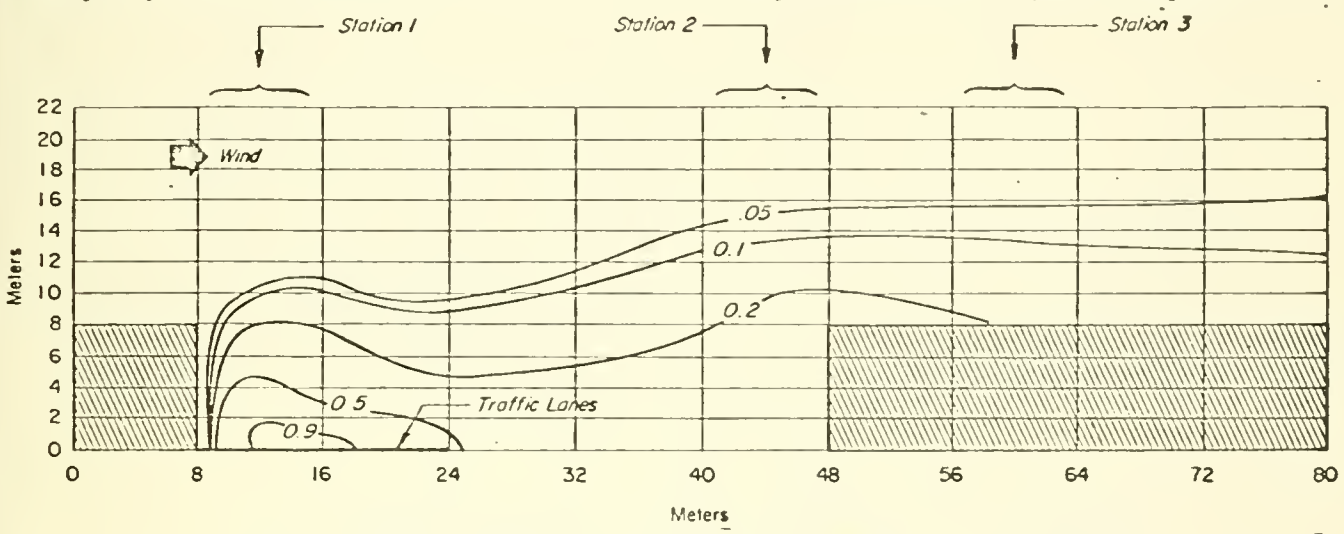


Figure 2. Concentration Field from Traffic in a Depressed Roadway Section

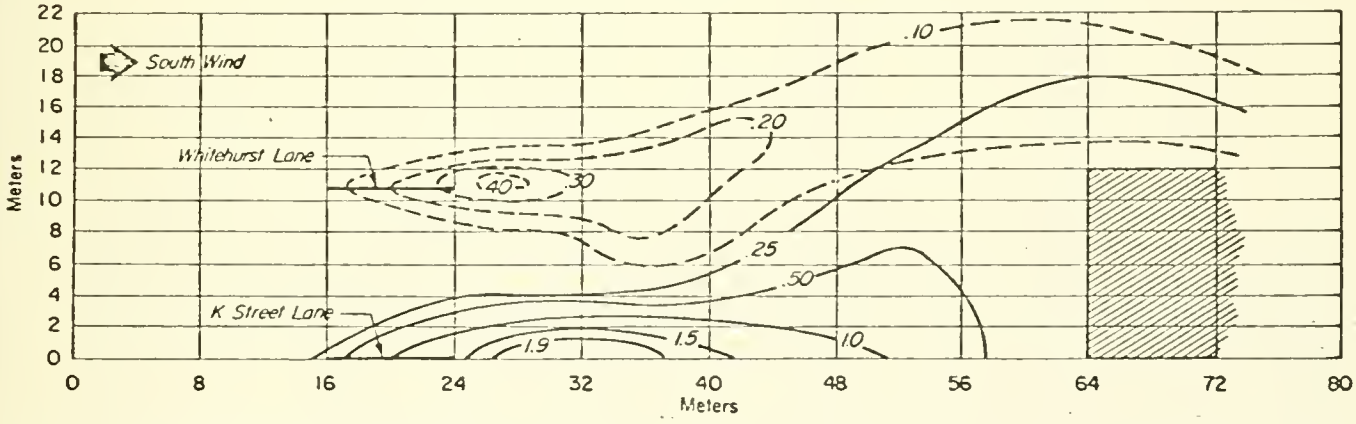


Figure 3. Concentration Fields per Unit Traffic Volume from Elevated and Ground Level Traffic Lanes for Flow Approaching a Bluff

An extensive measurement program for the purpose of providing data - traffic volumes for emissions input, wind speeds and directions, and carbon monoxide concentrations - for model calibration and validation was recently completed. The program included monitoring facilities at six roadway sites in the Washington, D.C., area. The sites were chosen to represent different highway design configurations and adjacent land use characteristics to assess model accuracy over a variety of conditions. Measurements were taken for 3 to 5 weeks at each site for a total time period of almost 21 weeks.

At each site, trailers containing monitoring equipment were placed on opposite sides of the

stability, determined hourly from meteorological observations taken at Washington National Airport, were used as model input. Normalized pollutant values were calculated in the form $\psi = \chi U/Q$ to compare with model predictions.

To insure a meaningful comparison between the model output and field observations, it was essential to establish criteria for selecting data sets which were suitable for model evaluation. The following requirements were adopted: (1) Completeness - the data was reduced to those hourly sets which contained all the information requisite for computation; (2) no calm winds were considered; (3) no cases where the angle between the roadway and the wind direction was less than 45° were

included; (4) cases with traffic volumes less than 10% of peak values were eliminated; and (5) occasions of very high wind speed were excluded. The second and third requirements eliminated conditions which violated mathematical assumptions of the model. The last two requirements eliminated cases where background concentration contributions would be expected to be large with respect to the roadway contribution.

Model performance can be determined by calculating calibration factors, R, the ratio of the observed to the predicted concentrations, for varying external parameters. Table 1 displays the overall calibration factors for ground-level concentrations for five of the six highway sites examined in this study.

Because the ground level concentration contributions measured at a sixth site (at the base of a 30' elevated section) were small and nearly indistinquishable from the local background levels, the derived calibration statistics were not considered to be valid and are not presented here. The other statistic presented in Table 1 is a best estimate of the variation about the mean agreement, based upon observational evidence. Values of S are obtained by dividing the standard deviation, σ, of the observed concentration by the average observed concentration. As the table indicates, the best prediction is for the two depressed highway sites. The average difference between predictions and observations for these two sites is within 20 percent.

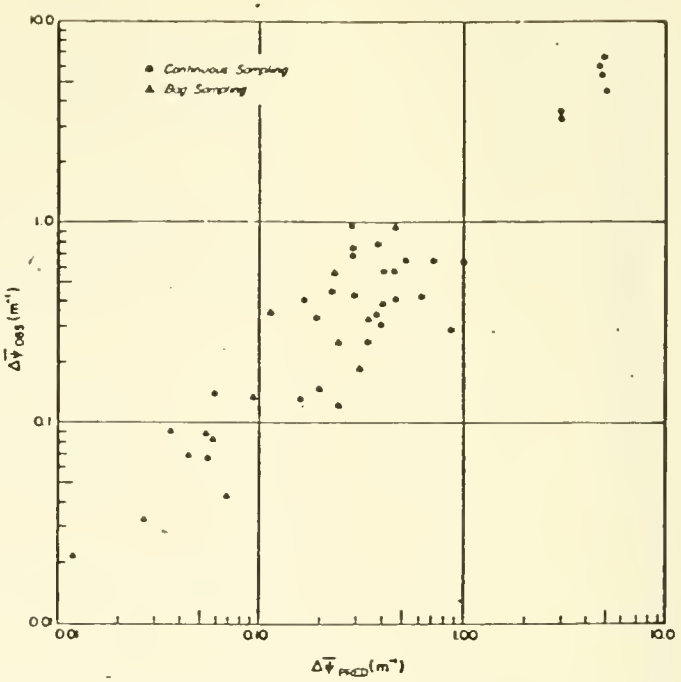


Figure 4. Summary Comparison of Observed vs. Predicted Normalized Concentrations for the Various Sites and Stability Categories

Table 1 Calibration and Validation Statistics

Highway Configuration			$R = \frac{\bar{\psi}_{obs}}{\bar{\psi}_{pred}}$	$S = \frac{\bar{\sigma}_{\psi obs}}{\bar{\psi}_{obs}}$
4-6	At-Grade	site 1	1.352	0.586
4-18		site 2	1.094	0.823
4-11	Depressed	site 1	1.197	0.514
4-13		site 2	0.843	0.936
Table 4-16	Elevated	site 1	1.450	0.512

Figure 4 displays in a single illustration the correspondence between the model predictions and the normalized ground-level CO contributions for all the sites and for each stability category. The graph was constructed from the results for each site. Each point therefore represents the average of varying numbers of hours of reduced data. The overall agreement between observed and predicted values is seen to be quite good over nearly three orders of magnitude of the range of values. Because the values of $\Delta\psi$ (observed minus background) are concentrations normalized with respect to roadway emission rates and inverse wind speed, they may be interpreted to be a measure of relative air pollution potential for the different locations. Thus Figure 4 shows the expected relation of observed to predicted for any given wind speed and emission rate over a wide range of site geometries and locations. The range of actual CO concentrations which can be estimated is, of course, much larger when the expected variations in emission rates and wind speeds are also considered.

IV. Summary

The dispersion of air pollutants emitted from vehicles on various roadways has been successfully predicted using a two-dimensional numerical simulation model, in which emitted material is in effect transported numerically through a vertical grid in a series of time steps, until a steady state concentration distribution is achieved. Horizontal and vertical wind speed values, and vertical diffusion coefficients, specified at each point in the grid, control the transport of the material. The wind and diffusivity fields are calculated as a function of the roadway design configuration, the nature of structures in the vicinity of the roadway, and meteorological conditions. These winds and diffusivities parameterize such effects as turbulent eddies on the lee side of obstructions.

The numerical model has been applied to the problem of the dispersion of carbon monoxide emitted from vehicles on various roadways in Washington, D.C. This model does incorporate the major effects

of highway design configuration - elevated, depressed and at-grade locations - and the resulting micrometeorological flows. Field observations of CO near the highway sites which were simulated were obtained for the validation and calibration of the model and to test the reliability and accuracy of the model predictions.

The study results indicate that numerical models which simulate the appropriate turbulent flows will adequately predict the air quality levels near roads. These models are valuable tools in determining the potential environmental impact of various highway designs.

References

1. B. A. Egan and J. R. Mahoney, "Numerical Modeling of Advection and Diffusion of Urban Area Source Pollutants," J. Appl. Meteor., 11, 312-322 (March 1972).

2. B. A. Egan, and J. R. Mahoney, "Applications of a Numerical Air Pollution Model to Dispersion in the Atmospheric Boundary Layer," J. Appl. Meteor., 11, 1023-1039 (October 1972).

3. D. B. Turner, "A Diffusion Model for an Urban Area," J. Appl. Meteor., 3, 83-91 (February 1964).

4. B. A. Egan, A. Epstein, M. J. Keefe, J. Lague, T. F. Lavery, E. C. Reifenstein, and B. H. Willis, "Development of Procedures to Simulate Motor Vehicle Pollution Levels, ERT Doc. P-343-FR, Environmental Research & Technology, Inc. (ERT),

5. D. S. Kircher and D. P. Armstrong, "An Interim Report on Motor Vehicle Emission Estimation," Environmental Protection Agency, Office of Air Quality Planning and Standards (October 1972).

APPENDIX B

B.1 ERT Air Quality Model (ERTAQ)

One of the diffusion models used in this study is a Gaussian plume model which follows the physical and mathematical basis described by Martin and Tikvart (1968). This model is applicable to the study of the air quality impact of a highway system on a plan-scale. It is most useful in the computation of ground level pollutant concentrations in a complex-source system such as intersections, for worst-case analyses.

The Gaussian Plume Equation

The model calculations are based upon multiple applications, and integrated forms, of the Gaussian plume equation which represents the concentration pattern downwind from a point source. The general form of the equation for the coordinate system presented in Figure B-1 is:

$$\chi(x,y,z;H) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left[-1/2\left(\frac{y}{\sigma_y}\right)^2\right] \left\{\exp\left[-1/2\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-1/2\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\} \quad (1)$$

where

- (x,y,z) are the along-the-wind, cross-wind, and vertical components of a cartesian coordinate system, such that the effluent source is located at or vertically above the origin (expressed in meters)
- H is the effective height of emission and, therefore, the centerline height of the plume (meters)
- Q is the source strength (grams/sec)
- σ_y, σ_z are the measures of cross-wind and vertical plume spread. These two parameters are functions of downwind distance and atmospheric stability (meters).
- u is average wind speed (meters/sec).

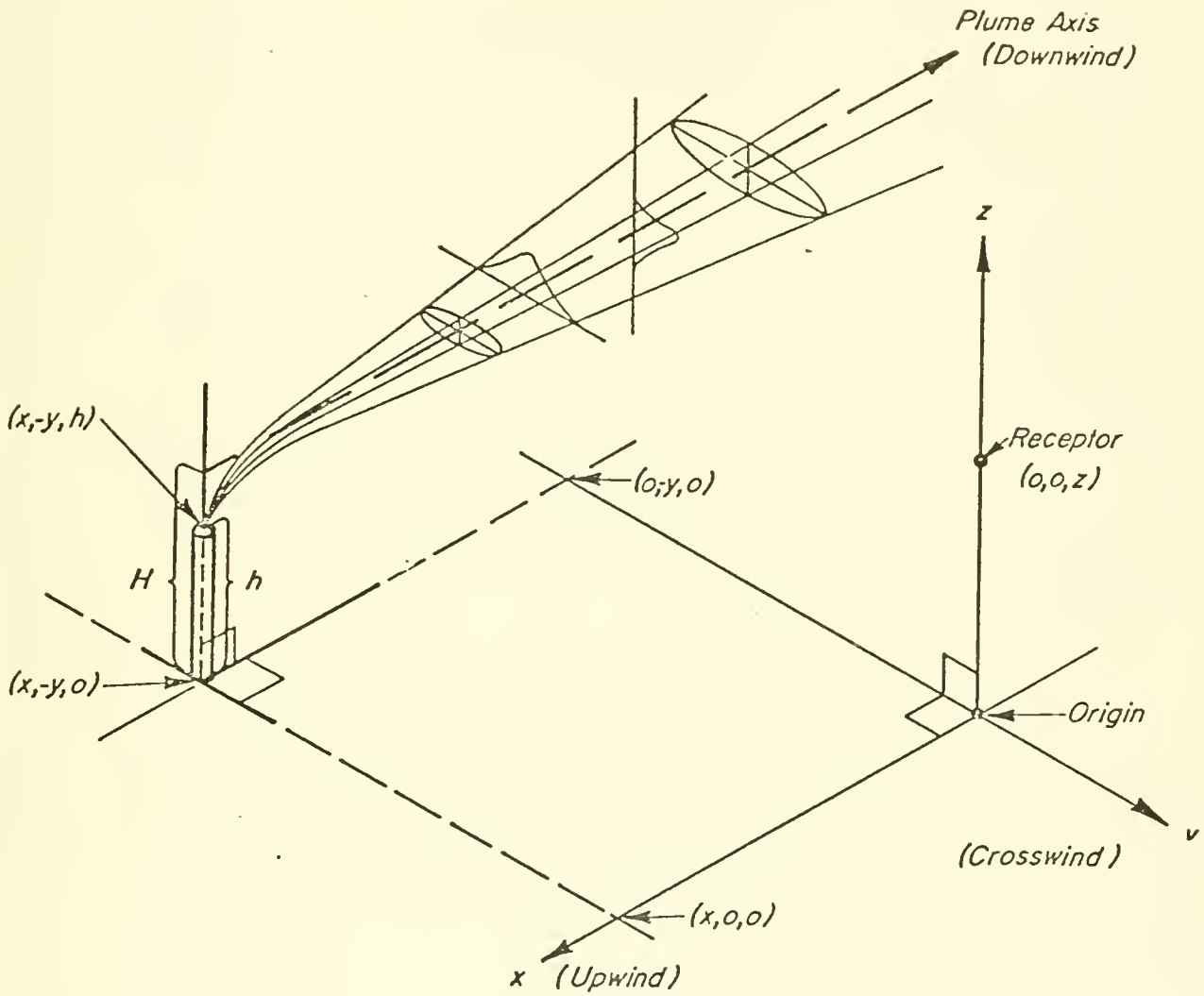


Figure B-1 Coordinate System Showing Gaussian Distributions in the Crosswind and Vertical Directions

The most important assumptions upon which the equation is based are the following:

- The wind speed and direction in the vicinity of the source are constant throughout the period of interest.
- When the effluent enters the atmosphere, the plume rises until it reaches an equilibrium altitude; the plume centerline height remains constant at all downwind distances after the equilibrium height is reached. Zero plume rise is assumed for vehicular emissions.
- At any downwind distance, the maximum concentration occurs at the plume centerline. The distribution of concentration values off the centerline is given by the product of two Gaussian, or bell-shaped curves.
- The concentration profiles described by the Gaussian form represent concentrations averaged over ten minutes to one hour.
- None of the effluent is lost from the plume. Therefore, when the plume boundary intersects the ground, it is assumed that all material is reflected back above the ground.
- The effluent emission rate is constant and the meteorological parameters determining plume form are constant; (i.e., the equation represents steady standard conditions).

For a line source distribution, the concentration at the point (o, o, z) in the coordinate system presented in Figure B-2 is the integral along the line of elemental strips of length $d\ell$ where:

$$x(o,o,z) = \int_{x_1, y_1}^{x_2, y_2} \frac{d\ell \cdot Q_\ell(x,y,H)}{2\pi\, \sigma_y \sigma_z\, u} \exp\left[-1/2\, y^2/\sigma_y^2\right] \cdot \left\{\exp -1/2 \left(\frac{z - H}{\sigma_z}\right)^2 + \exp\left[-1/2 \left(\frac{z + H}{\sigma_z}\right)^2\right]\right\} \quad (2)$$

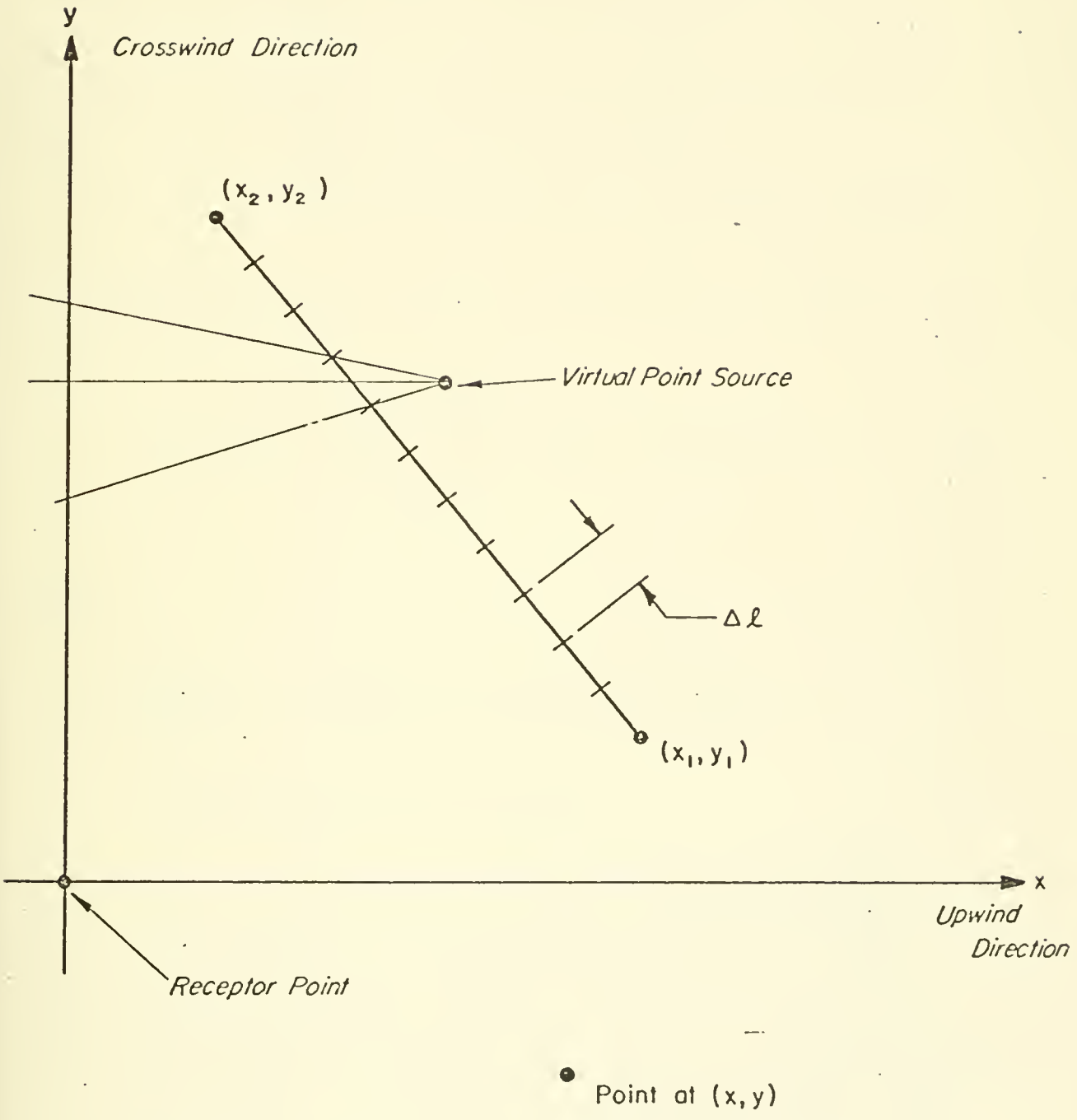


Figure B-2 Geometry for Determination of Concentration Due to Line Sources

where

x_1y_1 = downwind, crosswind source-receptor displacements of the first end point of the source,

x_2y_1 = downwind, crosswind source-receptor displacements of the second end point of the source,

ℓ = length of line segment, meters,

Q_ℓ = line source emission density, grams/meter-second.

The concentration for constant emission density, Q_ℓ may be written as:

$$x(o,\ o,\ z) = \frac{Q_\ell}{u} \int_{x_1,\ y_1}^{x_2,\ y_2} Vdf(x,z,H)hdf(x,y)d\ell \qquad (3)$$

where:

vdf(x,z,H) = a vertical distribution function,

hdf(x,y) = a horizontal distribution function.

Horzontal Distribution Function

Although the probability of wind direction is a continuous function over long time periods, for model computation purposes, discrete wind directions are specified with respect to a 16-point compass having 22.5° angular sectors. Over long periods, it is assumed that all wind directions within a given 22.5° sector occur with equal frequency. In this case, the Gaussian crosswind spread is replaced with sector averaging for point source applications. This procedure is based on the premises that: (1) wind direction is known by sector only, (2) the concentration at the sector centerline is a conservative estimate of values elsewhere within a sector, and (3) that a typical average value within a sector is given by averaging the one-hour Gaussian crosswind distribution across the sector.

However, the use of the uniform 22.5° crosswind distribution function for line source applications results in discontinuities in the downwind concentration profile due to geometric overlapping of sector contributions from the finite line source. For this reason, the triangular distribution was used for the line sources in the study region. This function minimized discontinuities in calculated concentrations at sector boundaries and achieves a more continuous downwind concentration profile. The function is defined by the formula:

$$hdf(x,y) = \frac{c(x) - |y|}{[c(x)]^2} \qquad (4)$$

where:

$$c(x) = 2x \tan (11.25^\circ) = 0.398\ x$$

Figure B-3 illustrates this procedure.

The numerical integration of Equation (4) is obtained by representing the line integral as a summation over a set of M virtual points, and displaced by upwind by an amount which increases the sector width c(x) by Δy.

$$\chi(0,\ 0,\ z) = \frac{Q}{u}\ \Delta\ell \sum_{k=\ell}^{M} vdf(x,\ z,\ H)\ hdf(x,\ y)$$

The modified sector width c' is then given by:

$$c' = c(x) + |\Delta y| = 0.398 \cdot x + |\Delta y|.$$

The modified sector width is illustrated in Figure B-2.

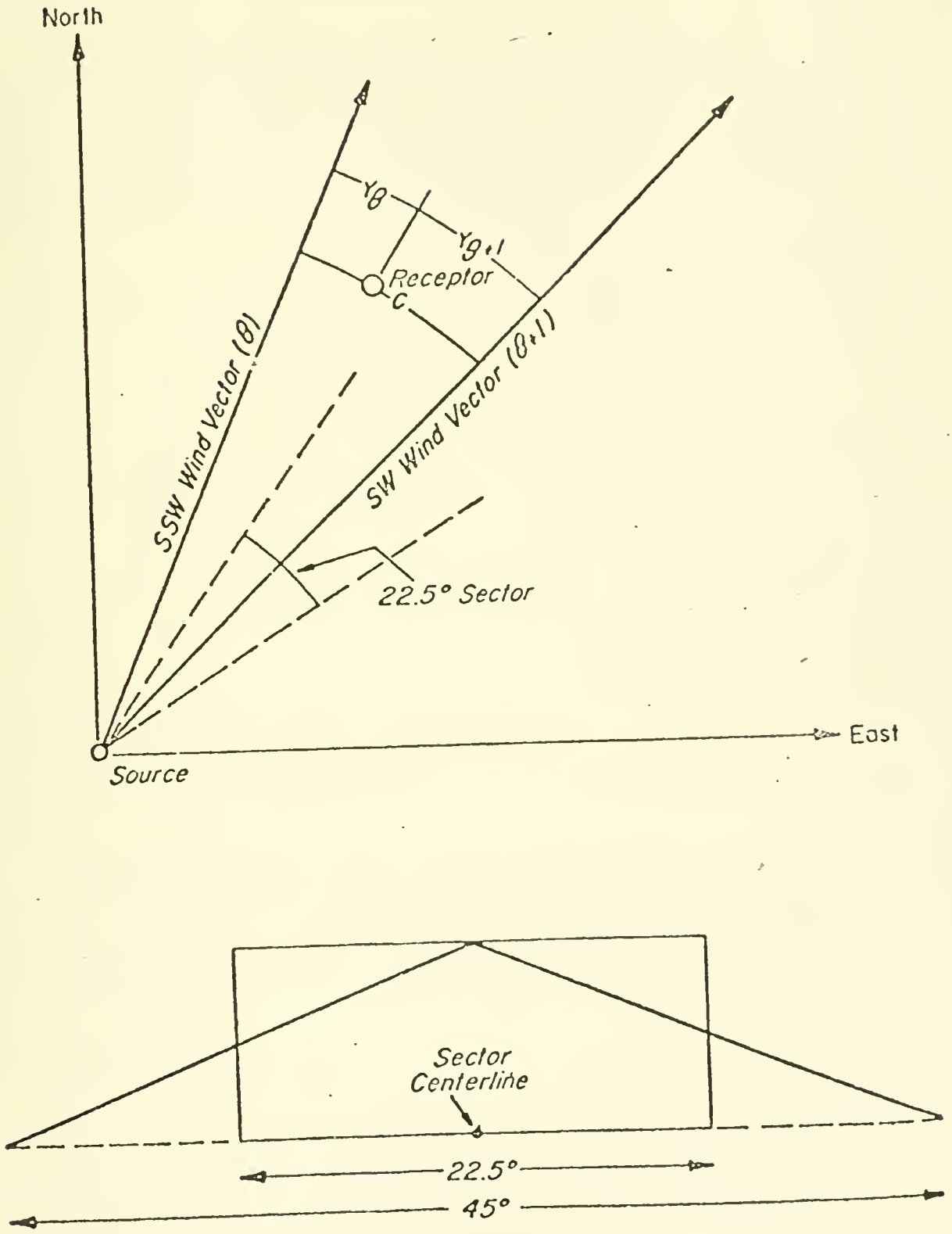


Figure B-3 Geometry of the Linear Interpolation Between Adjacent Wind Direction Sectors

Vertical Distribution Function

The vertical distribution function used by ERTAQ is the well-known Gaussian distribution, adjusted to include perfect reflection off the surface and complete mixing (after a varying distance depending on stability and mixing depth) throughout the mixing layer. The precise distribution is:

$$vdf(x,z,H) = \begin{cases} y(x,z,H) & \text{if } x \leq x_T \\ \left(2 - \frac{x}{x_T}\right) y(x,z,H) + \left(\frac{x}{x_T} - 1\right) \frac{1}{DM} & \text{if } x_T \leq x \leq 2x_T \\ \frac{1}{DM} & \text{if } x > 2x_T \end{cases} \quad (5)$$

where $y(x,z,H)$ is the reflected Gaussian equation.

$$y(x,z,H) = \frac{1}{\sqrt{2\pi}\,\sigma_z} \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] \quad (6)$$

and where:

DM = mixing depth (m)

σ_z = vertical dispersion coefficient (m)

x_T = trapping distance (m)

(x_T, the trapping distance is that distance (m) at which σ_z = 0.47 DM). The values of the dispersion parameters σ_z used in ERTAQ to simulate the dispersion of emissions from emission sources were those of Calder (1971) as expressed in the functional form:

$$\sigma_z = ax^b + c + d \quad (7)$$

The values a, b and c are specified by downwind distance as shown in Table B-1 and actually represent Pasquill-Gifford coefficients modified for urban areas. A discussion of d, an urban dispersion parameter, is presented in Section B.2.3.

TABLE B-1

DISPERSION PARAMETERS (σ_z) USED IN CALCULATING VERTICAL DISPERSION

		$x < 100$ m			$100 \text{ m} < x < 1{,}000$ m			$x < 1{,}000$ m		
	Stability Class	a	b	c	a	b	c	a	b	c
1	Extremely Unstable	0.174	0.936	0.0	0.011	0.89	9.6	0.001	1.89	9.6
2	Moderately Unstable	0.143	0.922	0.0	0.048	1.11	2.0	0.048	1.11	2.0
3	Slightly Unstable	0.123	0.905	0.0	0.119	0.196	0.0	0.110	0.915	0.0
4	Neutral	0.080	0.881	0.0	0.187	0.775	-1.4	2.61	0.450	-25.5
5	Stable	0.060	0.845	0.0	0.135	0.745	-1.1	52.6	0.150	126.0

Urban Dispersion

Special consideration of urban dispersion is accounted for in an urban program option developed from the Climatological Dispersion Model for the Environmental Protection Agency (Calder, 1971). The inclusion of this option allows for consideration of the special dispersion properties of urban areas and the buoyancy of vehicular exhaust. Urban dispersion properties are distinguished by:

- larger initial mixing of plumes from the turbulent eddies induced by buildings and other large structures;
- larger total dispersion from the increased roughness of the urban boundary surface.

These effects are accounted for in the definition of d, the depth of the initial mixing volume. A value of 4 m was selected as an appropriate mixing value.

Treatment of Area Sources

To simulate the TSP concentrations due to area source emissions (see Figure B-4), the equation relates area source emissions to concentrations at a given receptor as follows:

$$(0, 0, z) = \int_{x_1}^{x_2} dx \int_{y} dy \quad \frac{Q_A\ (x,y,H)}{\sqrt{2\pi}\ \sigma_z u} \cdot f(y) \left[\exp\left(-\frac{1}{2} \left(\frac{z - H}{\sigma_z} \right)^2 \right) + \exp\left(-\frac{1}{2} \left(\frac{z + H}{\sigma_z} \right)^2 \right) \right] \qquad (8)$$

where $f(y) = 1/c$ for 22.5° sector averaging and c = the sector width at the source element = $2 \tan (11.25^\circ) = 0.398\ X$.

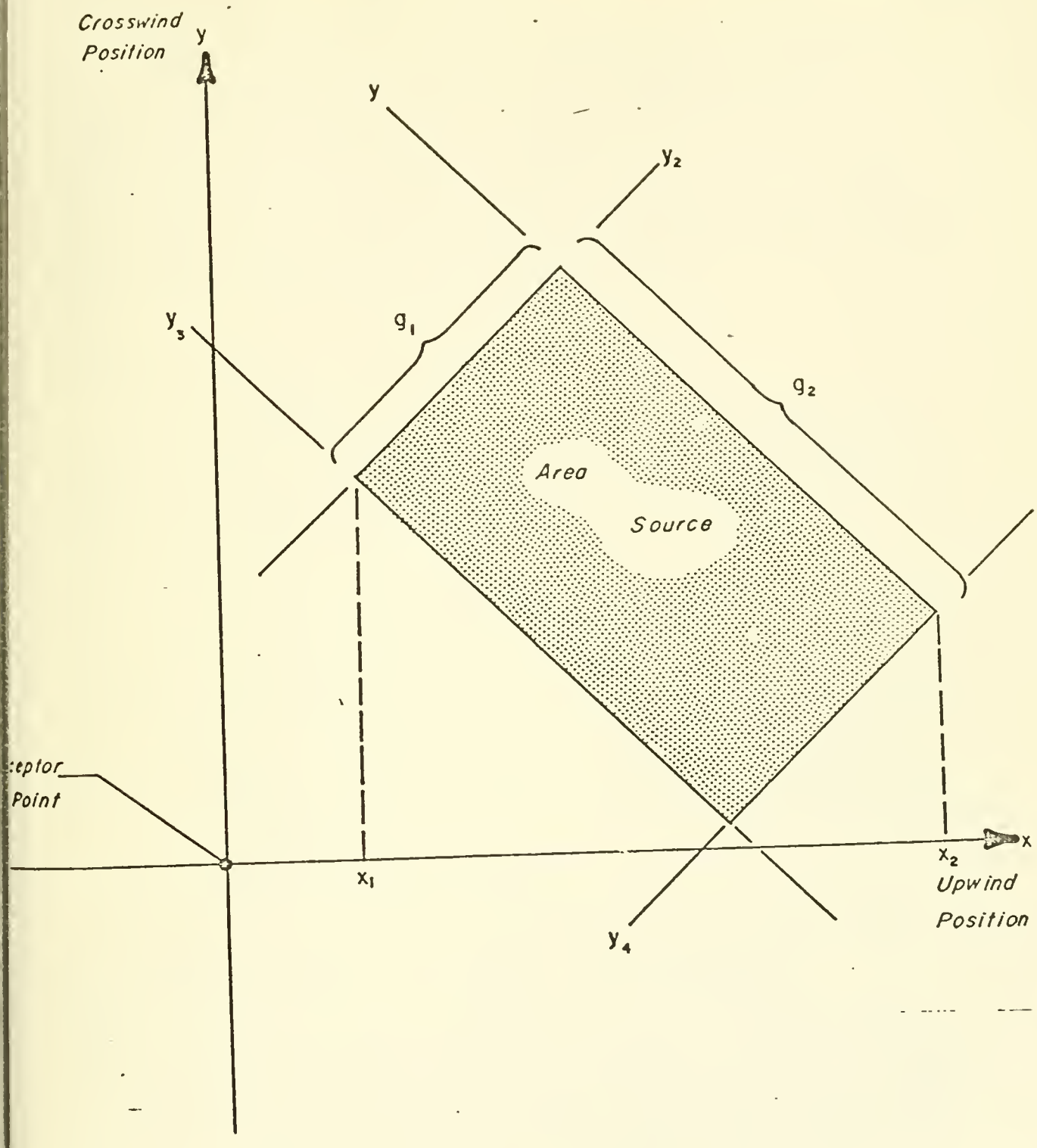


Figure B-4 Geometry for Area Source with Dimensions g_1, g_2 in the Horizontal Plane, Shown in the Receptor-Centered Wind Oriented Coordinate System

Computer realization of Equation (8) is achieved by dividing each area source into a number of rectangular elements oriented perpendicular to the assigned wind direction. The area source integration then involves the summation of contributions from each elemental area. This technique represents an important advancement over previous methods which simulate the contributions of area sources by a series of closely-spaced virtual point sources.

B.2 [illegible] ection-Diffusion Model (EGAMA)

The [illegible] configuration of a roadway, which determines the micrometeorological flow field and the resulting dispersion rates of vehicular emissions, has a fundamental effect on the magnitude of its air quality impact. This flow field is characterized by:

- substantial initial mixing of vehicular emissions within the aerodynamic wake region of the vehicle
- significant spatial variations of the wind and diffusivity fields resulting from obstructions to wind flow (regions of systematic reverse eddy flow can generally be expected)
- turbulent mixing rates varying as a function of height above the ground
- horizontal wind speeds generally increasing with height.

EGAMA, a numerical advection-diffusion simulation model based upon a conservation of mass equation, incorporates these micrometeorological flow characteristics and represents the current state-of-the-art in roadway dispersion modeling. The EGAMA model was extensively validated at six highway sites in Washington, D.C. Carbon monoxide measurements were taken on both sides of the roadways and at three heights along with concurrent meteorological measurements and traffic observations (to estimate CO emissions). Several hundred hours of concentrations, emissions, and meteorological data were measured for the validation purpose. It was found for the conditions assumed in the present study's analyses that the model adequately

predicts CO values for depressed (open cut) and at-grade roadways (Egan and Lavery 1973). That is, the true value is not expected to be more than 10% above or 50% below the model prediction, because of the several conservative assumptions made in the model use. The computer output provides the near field (less than 200-300 meters) pollutant concentration values as a function of downwind distance and height. This allows the determination of air quality at both ground-level and elevated receptors (e.g., building air intakes). Overall uncertainties in results due to use of the ERTAQ and EGAMA models are indicated in Figures B-5a and 5b.

The following discussion is a brief theoretical presentation of the model and its microscale grid system. Further discussion of the model's application may be found in the papers by Egan and Lavery (1973).

EGAMA Model Description

The advection and diffusion of a pollutant are governed by the tracer equation. This two-dimensional equation describing the change in concentrations resulting from horizontal advection, vertical advection, vertical diffusion, and source emission is

$$\frac{\partial \chi}{\partial t} = - U \frac{\partial \chi}{\partial x} - W \frac{\partial \chi}{\partial z} + \frac{\partial}{\partial z} \left(K \frac{\partial \chi}{\partial z} \right) + Q(x,z) \qquad (1)$$

where

- (x,z) are the downwind and vertical coordinates (meters) in a two-dimensional Cartesian system
- (x,z) is the concentration of the particular pollutant (mg/m^3)
- t is the time (seconds)
- $U(x,z)$ is the horizontal wind speed (m/sec)
- $W(x,z)$ is the vertical wind speed (m/sec)
- $K(x,z)$ is the turbulent diffusivity (m^2/sec) and
- $Q(x,z)$ is the source emission rate (mg/m^3/sec)

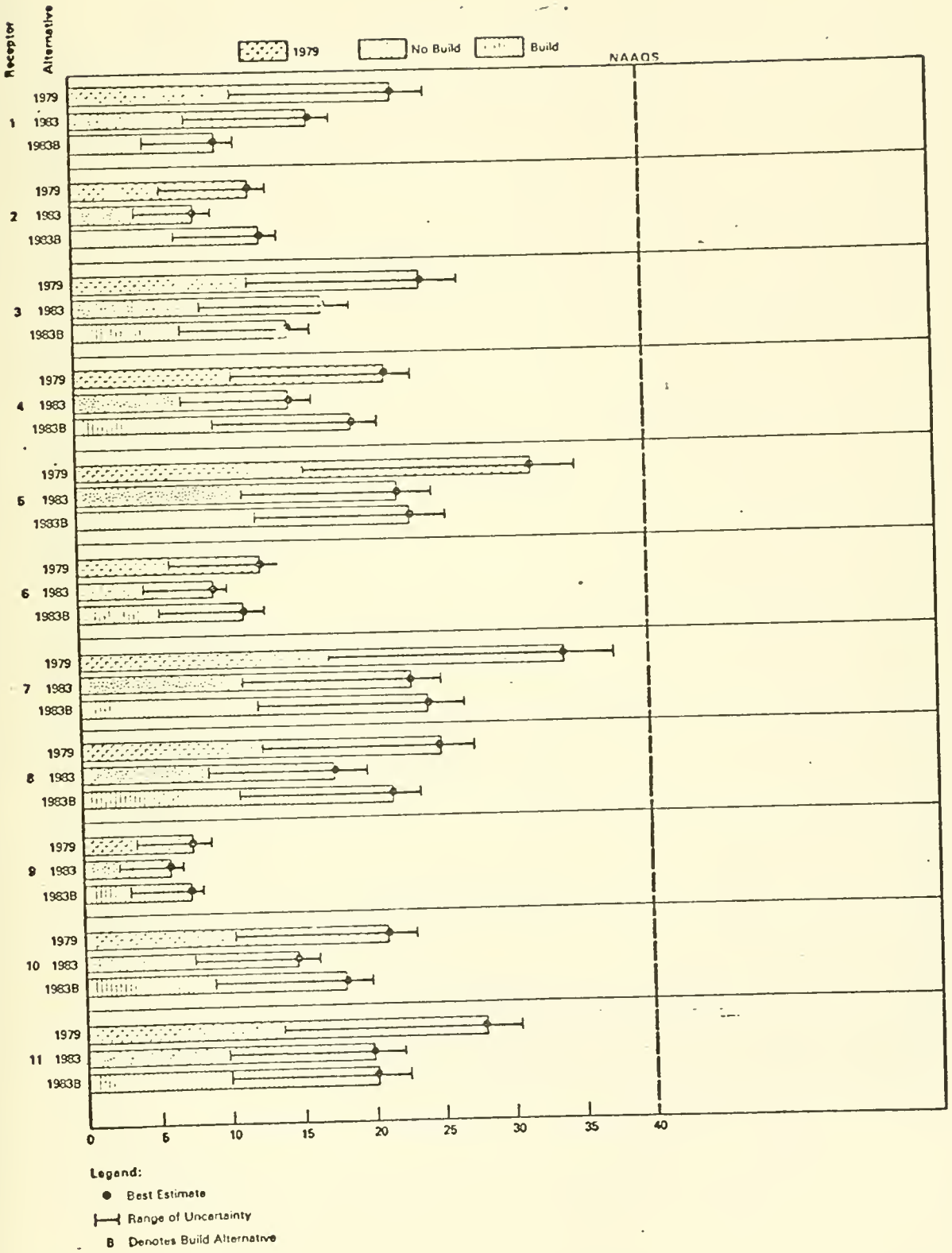


Figure B-5a Maximum Predicted 1-Hour Carbon Monoxide Concentrations at Selected Critical Receptors and Range of Model Uncertainty

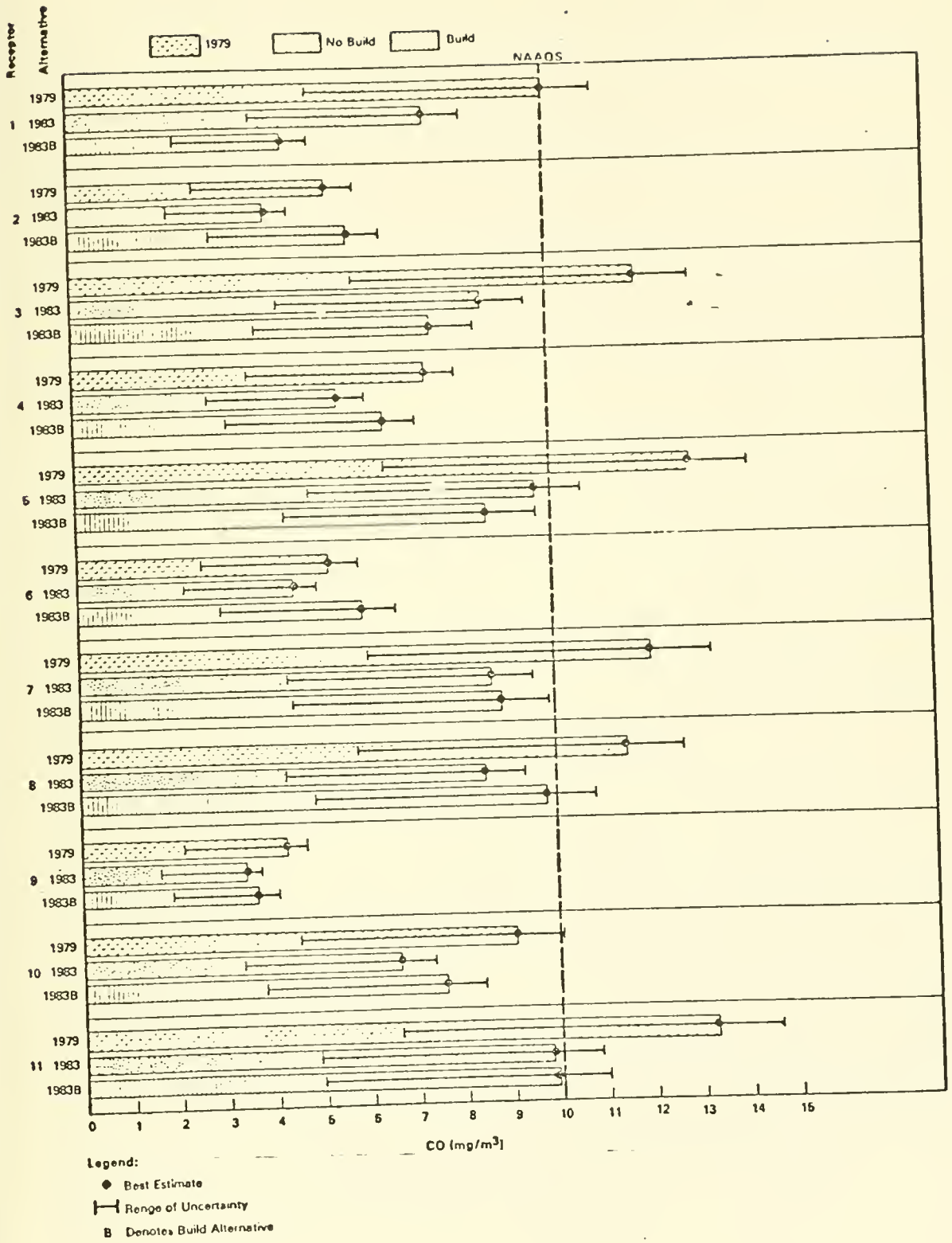


Figure B-5b Maximum Predicted 8-Hour Carbon Monoxide Concentrations at Selected Critical Receptors and Range of Model Uncertainty

To simulate pollutant dispersion across and downwind of a roadway, a vertical cross-sectional region enclosing the roadway is divided into a number of grid elements, and the partial derivatives in the tracer equation are approximated by finite differences corresponding to the dimensions of the two-dimensional grid elements. The finite-difference simulation for horizontal advection, vertical advection and vertical mixing in the governing equation is performed in three separate, sequential steps in the computational procedure.

If the horizontal dimensions of the grid elements are set equal to the width of a road lane and the vertical dimensions equal to a mean initial mixing depth of the aerodynamic wake region of a vehicle, traffic in different lanes can then be represented by volume source emission rates in the corresponding grid elements. Boundary conditions and initial values of the concentration field need to be specified for the grid cell representation. For most applications, the initial values of the concentration field are equal to zero; and similarly, the upwind (left) boundary values are set equal to zero. The steady-state solution is then generated. However, current pollution levels and upwind background levels can be used as initial values and boundary values for special situations.

Conventional finite-difference approximations in the two advection terms, $U\partial X/\partial x$ and $W\partial X/\partial z$, produce truncation errors which, in effect, introduce numerical "pseudo-diffusion" errors into the predicted quantities. This artificial upwind and downwind mixing rate of the material by the numerical scheme can be orders of magnitude larger than that resulting from the true atmospheric mixing process.

The pseudo-diffusion associated with the numerical advection term can be substantially reduced by utilization of one or more statistical moments of the concentration distribution within the grid element in the computation scheme. This model, therefore, provides an important improvement in the accuracy of simulating pollutant transport numerically in the near field of roadways.

The vertical diffusion component, $\partial/\partial z\ (K\partial X/\partial z)$, is simulated by a conventional forward-time, centered-difference technique modified so that variable vertical grid spacing can be specified. In regions where parameters or concentrations change rapidly with height, resolution and accuracy can be improved with smaller vertical grid spacing. In other regions (typically at high altitudes) where gradients are smaller, large grid spacings can be used.

Both the horizontal wind speed, $U(x,z)$, and vertical wind speed, $W(x,z)$ are calculated on the basis of conservation of mass and according to the "topography" in the grid system. A simple power law expresion for U is assumed to be valid at the left boundary, i.e., $U(x = 0,z) = U_1(z/z_1)^{\alpha}$, where

U_1 is a measured wind speed
z_1 is the height at which U_1 is measured, and
α is an externally imposed parameter depending on atmospheric stability conditions.

For computational purposes the wind direction is always perpendicular to the highway. To simulate the effect on concentrations of winds at small azimuth angles ($\theta = 0$ with perpendicular winds), the model reduces the wind speed in the advection terms by a factor of cos θ. The modification in essence simulates the effects of oblique wind angles on increasing the travel time of pollutants to corresponding positions normal to the roadway. The procedure is valid for θ less than about 67.5 degrees.

The wind fields for different obstacle configuations are calculated by assuming that various horizontal velocity profile modifications will result from the presence of obstacles to the flow and by requiring that the wind fields that result satisfy conservation of mass at each grid element. The fields calculated in this general EGAMA simulation are expected to be valid for typical roadway cross-sections where the roadway width is large with respect to the depression depth.

It should also be noted that the G.M. sulfate dispersion experiments (Chock 1977) have shown the dispersion rates in the immediate vicinity of vehicles are so rapid that the effect may be simulated by assuming initial source volume. This has been done in EGAMA (a 3 x 2m cross-section is assumed for this volume). The G.M. experiments also illustrated that the low rural dispersion rates normally used in the EPA highway model generally results in overestimates of roadside concentrations; a comparison made by ERT with EGAMA also indicated that its results were conservatively high, but not as high as those predicted by HIGHWAY for the same open road configuration (ERT 1979).

CANYON, Street Canyon Flow Submodel

As discussed above, the channel vortex flow is a very complex phenomenon. Both field studies and wind tunnel experiments indicate that for roof-top flow perpendicular to the street canyon:

1) A secondary vortex flow is induced in the obstructed sublayer by winds passing above the street canyon.
2) A strong shear stress layer develops just above the mean roof plane, while stress within the canyon is nearly constant.
3) The leeward building surface concentrations are almost always higher than the windward concentrations.
4) There is a general decrease in pollutant concentrations in the canyon with increasing roof-top wind speed.

Under the constraints of a limited experimental data base and the need for repeated model applications, a simple two-dimensional model, yet one that retains the basic physical principles and gross features of the channel vortex flow, has been developed. Following Hotchkiss and Harlow (1973), the street canyon flow is idealized as the two-dimensional vortex solution to a cross-wind passing over the top of a simple notch. This is assumed valid for perpendicular roof-top

flow over a long canyon formed by buildings of approximately equal height. Hotchkiss et al. derived an approximate solution for the horizontal velocity component, U:

$$U = \frac{U_o}{1-\beta}\left[e^{kz}(1 + kz) - \beta e^{-kz}(1 - kz)\right] \sin kx \qquad (2)$$

where

- U is the horizontal velocity component
- U_o is speed of the external flow at all points above the notch is e^{-2kH}
- k is $\frac{\pi}{L}$
- L is the width of the notch
- H is the depth of the notch
- x is the horizontal coordinate (x = 0 at the upper left corner of the notch and increases to the right), and
- z is the vertical coordinate (z = 0 at the upper left corner of the notch and increases toward the bottom of the notch)

The vertical velocity field is computed from conservation of mass.

From Equation (2), several aspects of the flow field are readily apparent.

1) The flow field is solely a function of the height and width of the notch and the external (roof-top) wind speed.
2) The horizontal profile is sinusoidal, with the maximum horizontal speed at the top of the notch equal to the speed of the external flow.
3) The velocity of the vortex is directly proportional to the speed of the external flow.
4) The depth of the vortex center (the depth at which the horizontal velocity is zero) varies with the height to width ratio (H/L) of the notch. Its horizontal position is always L/2.

The changing location of the vortex center over the continuous range of canyon geometries is displayed in Figure B-6. For tall buildings or a narrow street ($H/L \geq 4$), the center of the vortex flow is just below the roof plane. Ground-level velocities and the resulting pollutant dispersion would be negligible in this case, which represents an extremely deep canyon. At the other extreme ($H/L \geq 1/2$) - short buildings or a wide street - the vortex center is deep in the canyon. The limit of applicability occurs for a street width about three times the building height ($H/L \geq 1/3$). For (H/L) ratios less than 1/3, the street canyon option is replaced by the normal EGAMA situation.

A limited verification of the location of the vortex center can be obtained from Hoydysh's (1972, 1974) wind tunnel results for canyons with $H/L = 1$. Hoydysh found that the vortex center is located at a depth of about 1/3 the total canyon depth. This source configuration ($H/L = 1$) when simulated with our idealized flow field yields the nearly identical fractional depth of 0.31.

The eddy coefficients of diffusivity are computed by EGAMA as a function of roof-top wind speed and stability. Over level terrain (e.g., above the mean roof plane) they are usually expresed as a simple power function with height. Within the canyon, the eddy diffusivity was assumed constant and equal to that value computed by EGAMA just above the mean roof plane. In the external flow field (above the canyon) the simple power law form is followed.

Since the wind tunnel simulates a neutral environment, the model has been applied using neutral stability only. The San Jose field studies indicate that this is probably a good assumption. They showed little relation between observed CO concentrations and the atmospheric lapse rate. This probably reflects the dominance of mechanical mixing by flow obstructions and the motion of vehicles as compared to convective mixing.

The street canyon model was validated using the data collected by field studies in San Jose, California (Johnson 19). Concentration and flow field data were averaged by the eight 45^{o} roof-top wind sectors. Four of these wind sectors (north, east, south and west)

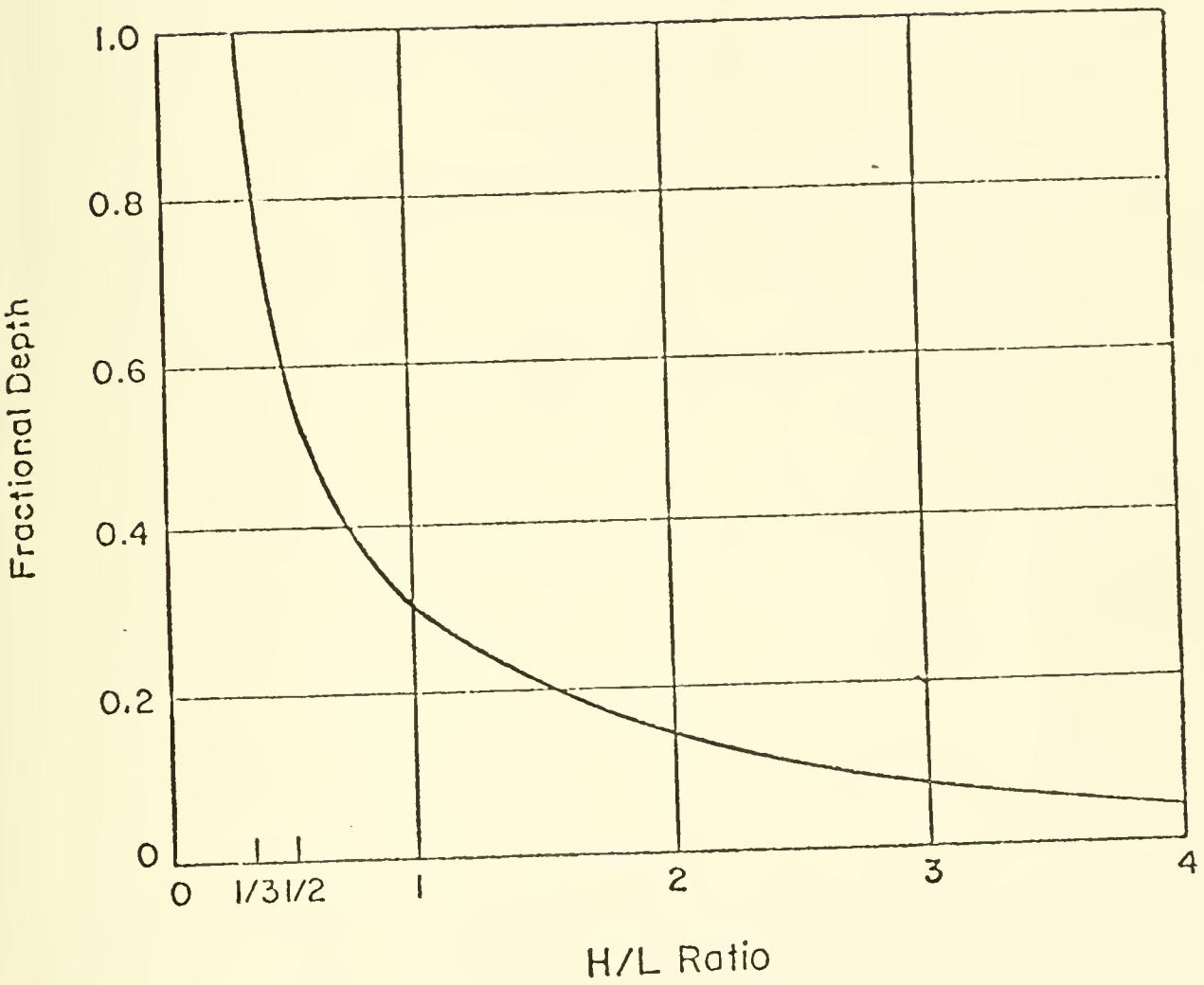


Figure B-6 Fractional Depth of Two-Dimensional Vortex Center as a Function of Depth to Width Ratios

were perpendicular to the two cross streets in the field study. Of these four available wind sectors half (north and west) were used to validate the street canyon model.

Figure B-7 shows the predicted concentration field and the accompanying average observed concentrations (in parentheses) for a westerly roof-top wind of 1.0 m/sec. The two observation stations are located far enough from intersections to allow a vortical circulation to dominate the local flow field and justify comparison with the two-dimensional model. Given the simplicity of the assumed model flow field and the use of estimated traffic emissions, the concentration fields agree remarkably well. The predicted cross-street CO gradient is larger than observed, but only by a factor of 1.5. The vertical CO gradients are in even closer agreement. In the same manner the concentration fields of Figure B-8 for a northerly roof-top wind of 1.4 m/sec can be compared. Not enough observational data is available to accurately validate the cross-street concentration gradient. The vertical gradients agree well.

It was found that the predicted concentrations very nearly obeyed the inverse relation:

$$\chi(x,z) = \chi_o(x,z) \frac{U_o}{U} \qquad (3)$$

where χ_o and U_o are some reference pollutant concentration and roof-top wind speed, respectively. Thus, the concentration fields predicted by the street canyon model can be linearly scaled to any roof-top wind speed. Overall uncertainties resulting from use of the street canyon model yield results similar to those for the EGAMA model, as reflected in Figure B-5.

Higher microscale CO concentrations (i.e., link-related concentrations of CO exclusive of background) were calculated at cross-sections #7 (Huntington Avenue at the Gloucester Apartments with 9.2 $\mu g/m^3$ versus 6.2 at Commonwealth Avenue), #5 (Stuart Street with 8.1 $\mu g/m^3$), and #3 (Dartmouth Street with 7.6 $\mu g/m^3$).

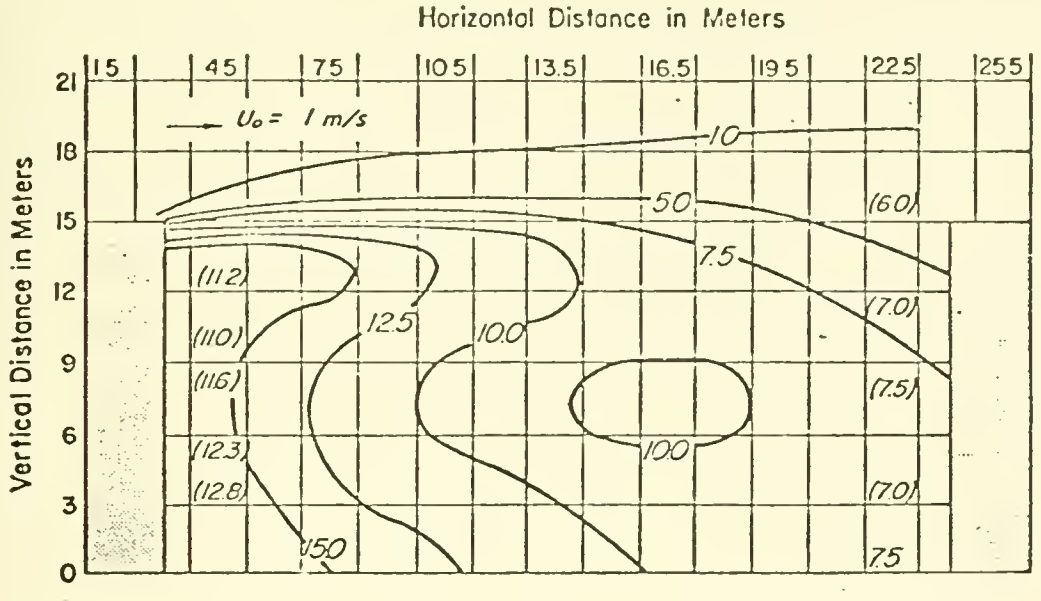


Figure B-7 Comparison of Observed CO Concentrations (Given in Parenthesis) for Westerly Roof-top Wind of 1.0 m/sec. in San Jose Field Experiment and Corresponding Concentration Field Predicted by CANYON Model

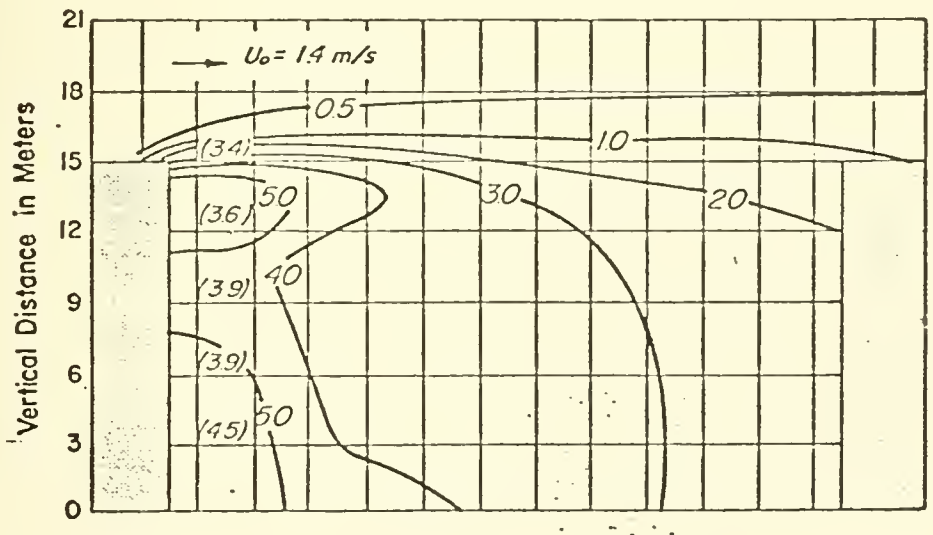
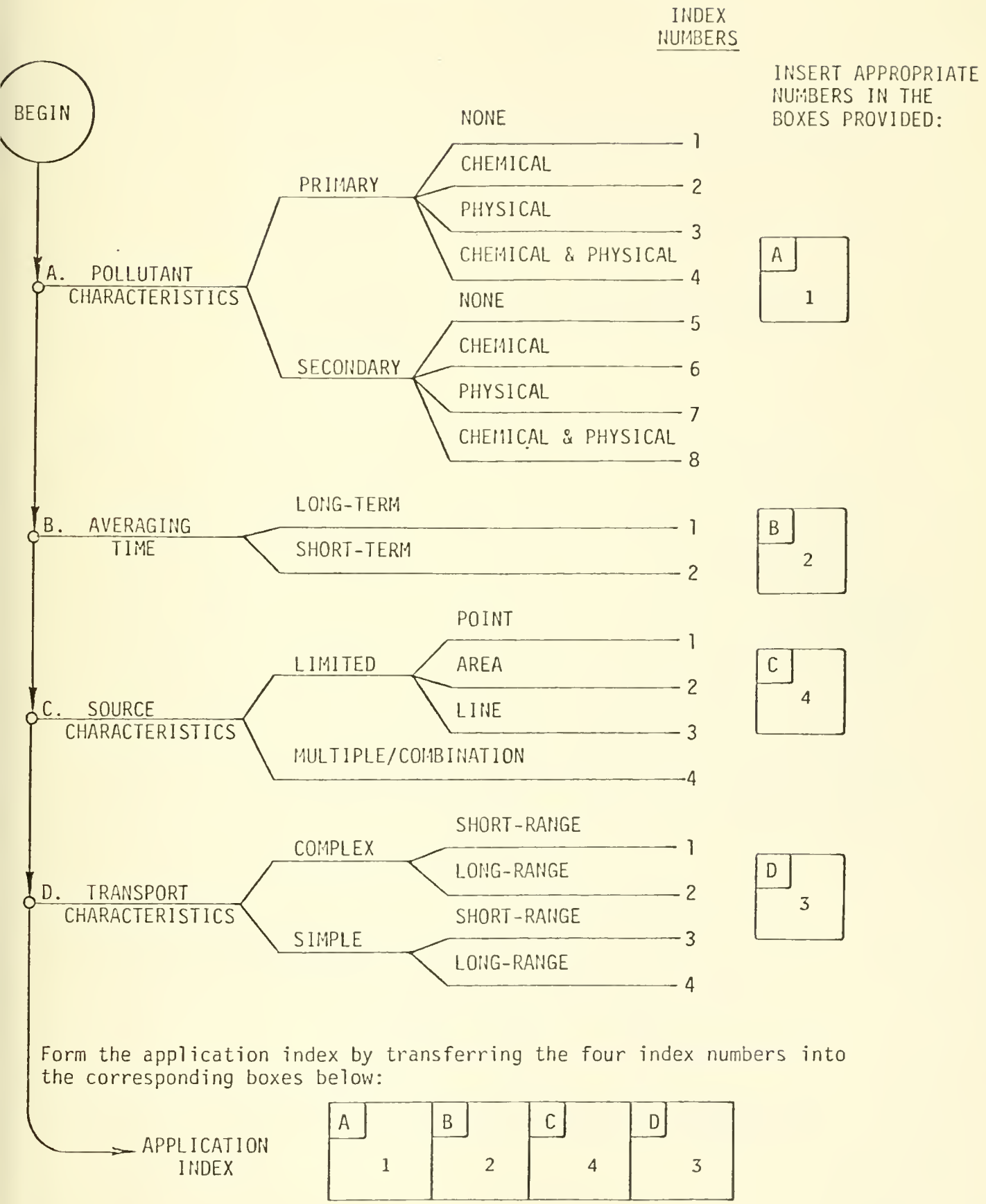


Figure B-8 Comparison of Observed CO Concentrations (Given in Parenthesis) for Northerly Roof-top Wind of 1.4 m/sec. in San Jose Field Experiment and Corresponding Concentration Field Predicted by CANYON Model

These concentrations tend to confirm that the area is currently a nonattainment area for CO. Thus, pollutant concentration over the next few years must be reduced to bring Back Bay CO levels within the 10 $\mu g/m^3$ 8-hour ambient air quality standards, as specified in the Boston Transportation Control Plan as part of the Massachusetts Implementation Plan. A combination of the FMVCP and a new Inspection/Maintenance program adopted in December 1979 offer the prospect that the entire Boston Metropolitan Area will be attaining for CO by or before 1987 (Massachusetts Implementation Plan 1979).

APPLICATION CLASSIFICATION FORM



Form the application index by transferring the four index numbers into the corresponding boxes below:

APPLICATION INDEX

A	B	C	D
1	2	4	3

EVALUATION FORM

Part A: Abstract and References

Study Model: ERTAQ

References: Briggs, G.S., 1970: Some Recent Analyses of Plume Rise Observation, Second International Clean Air Congress of the International Union of Air Pollution Prevention Association, Washington, D.C.

Pasquill, F., 1961: Atmospheric Diffusion, D. Van Nostrand (London).

Turner, D.B., 1969: Workbook of Atmospheric Dispersion Estimates, U.S. Dept. HEW, Public Health Service, NAPCA, Cincinnati, Ohio.

Abstract: ERTAQ is a steady-state sector-averaged Gaussian plume model that calculates concentrations of up to six pollutants from an unlimited number of point, line, and area sources. The model may be operated in either the "sequential" mode to calculate one, three, or 24-hour concentrations for analysis of historical "worst-case" impacts or in the "climatological average" mode to calculate long-term averages for periods represented statistically by stability wind-roses. Dispersion coefficients may be user-specified. In the sequential mode, a fourth class of source, "tall stacks", is available that provides for optional use of distinct dispersion coefficients more representative of this class of source. The model may be applied in both flat and hilly terrain. Up to 128 receptor points may be specified, at each of which the user may specify background concentrations as well as calibration factors. The contributions of individual sources to selected receptors may be isolated at the user's option. In addition, program options are available for user-specified input format, storage of output files, and manipulation of the results of intermediate computations.

Classification: SEMIEMPIRICAL/STEADY STATE

Application Index: 1243 Reference Model: PAL

Application Description:

Urban, Short-term, Conservative Pollutants, Simple Terrain

Model Applicability: Applicable [x] Not Applicable [ ]

Note: The reverse side of this form for documenting the equations is not shown.

EVALUATION FORM

Study Model: ERTAQ

Equations:

$$X = \frac{Q}{u} g_1 g_2$$

For sources other than "tall stacks," at user's option, the crosswind dispersion function g_1 may be sector-averaged over 22.5° by

$$g_1 = \frac{1}{2x \tan(\pi/16)}$$

For "tall stacks," the crosswind dispersion function g_1 is given by the statistically "expected" value within the 22.5° sector for receptors within the downwind sector, i.e.

$$g_1 = \frac{1}{\pi x/8} \operatorname{erf}\left(\frac{x\ \pi/16}{\sigma_y \sqrt{2}}\right) ;$$

for receptors in the sectors adjacent to the downwind sector,

$$g_1 = \frac{1}{\sqrt{2\pi}\ \sigma_y} \frac{1-\operatorname{erf}\left(\frac{\pi x}{16\ \sigma_y \sqrt{2}}\right)}{2-\operatorname{erf}\left(\frac{\pi x}{16\ \sigma_y \sqrt{2}}\right)}$$

This formulation avoids the difficulty of using centerline one-hour values when accumulating concentration estimates for multiple-hour averages.

The vertical dispersion function g_2 is given by

$$g_2 = \sqrt{\frac{2}{\pi}} \frac{1}{\sigma_z} \left\{ \exp\left[-\frac{1}{2} \left(\frac{H}{\sigma_z} \right)^2 \right] + \sum_{j=1}^{\infty'} \left[\exp\left\{ -\frac{1}{2} \left(\frac{H+2jL}{\sigma_z} \right)^2 \right\} + \exp\left\{ -\frac{1}{2} \left(\frac{H-2jL}{\sigma_z} \right)^2 \right\} \right] \right\},$$

where

L is mixing depth

H is height of plume centerline above the ground-level receptor.

Terrain Correction (tall stacks only):

$$H = H_s + \Delta H - T_f \times \text{Min}\,(z_r - z_s,\ H_s + \Delta H),$$

wherein

H is height of plume above terrain at receptor

H_s is height of stack above stack base

ΔH is plume rise

Z_r is topographic height of receptor (above sea-level)

Z_s is topographic height of stack base (above sea-level)

T_f stability dependent, user-specified terrain correction factor.

For a line source distribution, the concentration at the point (o, o, z) in the coordinate system is the integral along the line of elemental strips of length d where:

$$x\,(o,o,z) = \int_{x_1,y_1}^{x_2,y_2} \frac{d\ell \cdot Q_\ell(x,y,H)}{2\pi\,\sigma_y\sigma_z} \exp\left[-1/2\; y^2/\sigma_y^2\right] \cdot \left\{\exp -1/2\,\left(\frac{z-H}{\sigma_z}\right)^2 + \exp\left[-1/2\,\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\}$$

where

x_1,y_1 is downwind, crosswind source-receptor displacements of the first end point of the source,

x_2,y_2 is downwind, crosswind source-receptor displacements of the second end point of the source,

ℓ is length of line segment, meters,

Q_ℓ is line source emission density, grams/meter-second.

To simulate the concentrations due to area source emissions, the equation relates area source emissions to concentrations at a given receptor as follows:

$$\chi(o,o,z) = \int_x^{dx}\int_y^{dy} \frac{Q_A\,(x,y,H)}{\sqrt{2}\;\sigma_z\;u} \cdot f(y)\left[\exp\,(-1/2\,\left(\frac{z-H}{\sigma_z}\right)^2 + \exp\,(-1/2\,\left(\frac{z+H}{\sigma_z}\right)^2\right]$$

where

f(y) is 1/c for 22.5° sector averaging

c is the sector width at the source element = 2 tan $(11.25^{\circ})x = 0.398\ x$

EVALUATION FORM

Part B: Importance Ratings

Application Index:

Application Element	Importance Rating	
	Initial	Modified[a]
Source-Receptor Relationship	M	M
Emission Rate	M	M
Composition of Emissions	L	I
Plume Behavior	H	H
Horizontal Wind Field	M	M
Vertical Wind Speed	L	L
Horizontal Dispersion	H	H
Vertical Dispersion	H	H
Chemistry and Reaction Mechanism	L	I
Physical Removal Processes	L	L
Background, Boundary, Initial Conditions	M	M
Temporal Correlations	M	M

[a]With the exception of the designation of IRRELEVANT elements, it is expected that at most one CRITICAL designation and possibly one other modification may be made.

EVALUATION FORM

Part C: Treatment of Elements

Application Index: 1243

Application Element: Source-receptor relationship

Reference Model: PAL
Treatment:

Arbitrary location for each point, line, and area source (limit 30 of each type).

Line sources treated as one-dimensional.

Arbitrary release heights for point, line, and area sources.
Assumes flat terrain.
Precise separation for each source-receptor pair.
Area source sides restricted to be along specific grid directions.
Line sources can assume any orientation and may be inclined or curved.
Receptors located at specific arbitrary height above ground.

Study Model: ERTAQ
Importance Rating: Medium
Comparative Evaluation: Comparable
Treatment:

Unlimited number of point, area and line sources at any locations.
Up to 128 receptor points at any selected location.
Unique topographic elevation for each receptor.
Receptors must be at ground level with respect to reflection.

Can use elevated elevated receptors as option

Application Element: Emission rate

Reference Model: PAL
Treatment:

Single arbitrary emission rate for each point and area source.

Allow variation along line sources.

Diurnal variation of emissions by source type.

Study Model: ERTAQ
Importance Rating: Medium
Comparative Evaluation: Better
Treatment:

Unique emission rate for each source that may be varied according to diurnal, weekly, or monthly scheduling.

EVALUATION FORM

Part C: Treatment of Elements

Application Element: Plume Behavior

Reference Model: PAL
Treatment:
Briggs plume rise
Partial plume rise and final plume rise.

Study Model: ERTAQ
Importance Rating: High
Comparative Evaluation: Comparable
Treatment:
Briggs final plume rise formulas.
Stack tip downwash (Gifford) for tall stacks.
If plume height exceeds mixing height, concentrations further downwind assumed equal to zero.
Plume and mixing depth both respond to terrain.

Application Index: 1243

Application Element: Horizontal Wind Field

Reference Model: PAL
Treatment:
Constant, uniform (steady state) wind assumed.
Wind speed corrected for release height option based on power law variation, exponents from Irwin (1977).

Study Model: ERTAQ
Importance Rating: Medium
Comparative Evaluation: Comparable
Treatment:
Wind direction constant at all heights over all space.
Wind speed varies with height according to user specified power laws, dependent on stability class.

EVALUATION FORM

Part C: Treatment of Elements

Application Element: Vertical Wind Field

Reference Model: PAL
Treatment:

Assumed equal to zero.

Study Model: ERTAQ
Importance Rating: Low
Comparative Evaluation: Comparable
Treatment:

Assumed equal to zero except as implied by terrain correction factors.

Application Index: 1243

Application Element: Horizontal Dispersion

Reference Model: PAL
Treatment:

Semi-empirical-steady state.
Pasquill-Gifford horizontal dispersion parameters (Pasquill, 1961)
3-minute averaging time (Pasquill, 1976)-increased horizontal dispersion expected for averaging times of 1-hour.
Surface roughness not treated explicitly.
Option for initial horizontal source dimension.

Study Model: ERTAQ
Importance Rating: High
Comparative Evaluation: Comparable
Treatment:

Gaussian plume sector averaged in several ways (22.5° or triangular) depending upon application.
5 stability classes used with user-specified dispersion coefficients.
Different classes of sources may have different coefficients.
"Urban" and "Rural" options.

EVALUATION FORM

Part C: Treatment of Elements

Application Element: Vertical Dispersion

Reference Model: PAL
Treatment:
Semiempirical-steady state Gaussian plume function assumed.
5 stability classes as defined by Turner (1964).
Neutral stability split into day/night cases giving 6 classes in all.
Dispersion coefficients taken from Turner (1974).
Surface roughness not treated explicitly.
Option for initial vertical source dimension.

Study Model: ERTAQ
Importance Rating: High
Comparative Evaluation: Comparable
Treatment:
Semiempirical-Gaussian plume.
5 stability classes used with user-specified dispersion coefficients.
Different classes of sources may have different coefficients.
"Urban" and "Rural" options.
Option for initial vertical source dimension.

Application Index: 1243

Application Element: Physical Removal

Reference Model: PAL
Treatment:
No explicit physical removal processes incorporated.

Study Model: ERTAQ
Importance Rating: Low
Comparative Evaluation: Comparable
Treatment:
Dry deposition only.
Exponential decay using user-specified half-life decay factors.

EVALUATION FORM

Part C: Treatment of Elements

Application Index: 1243

Application Element: Background, Boundary, Initial Conditions

Reference Model: PAL
Treatment:
No provision for constant background.
Boundary conditions: perfect reflection at the ground and at the top of mixing layer.

Study Model: ERTAQ
Importance Rating: Medium
Comparative Evaluation: Comparable
Treatment:
Background value may be specified for each receptor or all receptors.
Perfect reflection at ground and at top of mixing layer.
Mixing layer follows terrain with correction factors.

Application Element: Temporal Correlations

Reference Model: PAL
Treatment:
Input hourly wind speed, wind direction, stability, and mixing height.
Emission rates: each emission source type is allowed a diurnal variation of emissions.

Study Model: ERTAQ
Importance Rating: Medium
Comparative Evaluation: Comparable
Treatment:
Not treated explicitly, except emission rate for each source which may be varied according to diurnal, weekly, or monthly scheduling.

EVALUATION FORM

Part C: Treatment of Elements

Application Index: 1243

Application Element:

Reference Model:
Treatment:

Two irrelevant elements:

- composition of emissions
- chemistry and reaction mechanism

Study Model:
Importance Rating:
Comparative Evaluation:
Treatment:

Application Element:

Reference Model:
Treatment:

Study Model:
Importance Rating:
Comparative Evaluation:
Treatment:

EVALUATION FORM

Part D: Technical Comparison

Application Index: 1243 Reference Model: PAL Study Model: ERTAQ

Importance Rating of Application Elements	Number of Treatments				Comparative Rating of Study Model
	Total	BETTER	COMPARABLE	WORSE	
CRITICAL					
HIGH			3		Comparable
MEDIUM		1	4		Comparable
LOW			2		
IRRELEVANT	2	XXX	XXX	XXX	
	Total	(Should equal 12)			

TECHNICAL EVALUATION Comparable

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I

J F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

September 20, 1979

Kenneth Himmel
Vice President
Urban Investment and Development Company
John Hancock Tower, 45th Floor
200 Clarendon Street
Boston, MA

Dear Mr. Himmel:

As you have requested, Tom Wholley of the Air Branch, EPA Region I, has reviewed the outline of the air quality analysis for the forthcoming Copley Place Environmental Impact Statement (EIS). In addition, Mr. Wholley met with Scott McCandless, HMM Associates, on September 14, 1979 to discuss the details of the report.

Based on information provided to date, EPA believes that the methodology to be used for the air analysis is acceptable.

Thank you for providing EPA the opportunity to have input at this early stage.

Sincerely,

Elizabeth A. Higgins

Elizabeth A. Higgins
Environmental Protection Specialist
Environmental & Economic Impact Office

cc: Susan Cooke
Tom Wholley

The construction noise levels associated with Copley Place will be within the applicable BAPCC regulations at all receptor locations except #1, the Gloucester Apartment Building. At this site, noise levels are expected to peak at 75.6 dBA (L_{eq}) or 76.0 to 77.0 dBA (L_{10}). This is 1 to 2 dBA over the peak construction noise level of 75 dBA (L_{10}) allowed for residential land uses. Simple abatement measures such as staggering equipment usage so that it is not all in operation simultaneously, or retrofitting some of the loudest equipment with mufflers, should suffice to reduce peak noise levels by 1 to 2 dBA. It should also be noted that the construction noise model is conservative and assumes old equipment and high levels of peak activity, two factors which may or may not occur during actual construction. See Response S-2-9 for a table outlining construction noise levels and BAPCC standards.

The values for L_{eq24} and L_{dn} have been recalculated to correct for the error cited by EPA. The correct values were calculated using the equation:

$$10 \text{ Log } \sum_{1}^{n} \text{ antilog } \frac{\text{hourly } L_{eq}}{10} - 10 \text{ Log } n$$

The correct values are as follows:

L_{eq} = 68.7 rather than 66.65 dBA

L_{dn} = 64.0 rather than 62.9 dBA.

Noise levels associated with the Copley Place HVAC system, at six receptor locations, are presented in Table 5.3 of the Copley Place Noise Levels Report.* They are as follows:

Receptor	HVAC Noise
1	54.0 dBA
2	43.7
3	55.0
4	58.9
5	55.2
6	47.8

Receptor #4 is located at Yarmouth Street, adjacent to the Southwest Corridor deck. Predicted noise levels at this receptor give a good indication of the Copley Place vent noise on the deck.

According to the acoustical engineer** for the Southwest Corridor project, a ventilation fan will be located 10 feet above the building on Yarmouth Street closest to the project. This fan wil be muffled to achieve a noise level of 50 dBA at fifteen feet from the point of exhaust. It will be more than 15' feet above the ground.

To be conservative, 50 dBA was assumed for the Southwest Corridor vent noise at receptor #4, and this was logarithmically added to the 58.9 dBA of Copley Place vent noise. The resulting combined vent noise level is 59.4 dBA.

---

* HMM Associates, December 1979.

** Phone conversation with Larry Whittick, Bolt, Beranek & Newman, December 10, 1980.

S-1-2

Bolt Beranek & Newman is engaged in a continuing wind and CO dispersion analysis. The continuing studies are being done in parallel with the detailed engineering design for the Copley Place ventilation systems. The developer expects to have results from them in February or March. As these results are finalized, they will be made available to EOEA and to DEQE.

S-1-3

UIDC has investigated the feasibility of a "greywater" reuse system for the hotels at Copley Place. Neither Marriott nor Western International has previously sponsored such a system. To the best of our knowledge no such design has been incorporated in any major highrise hotel in the country. Both Copley Place hotel operators have indicated that they are not interested in providing for such a system at Copley Place. The provision of a greywater system entails building a double plumbed system. The costs of such a system would be considerable. The system would require additional piping and pumping capability, and probably some filtering systems that would be costly and which would require additional maintenance. The premium costs to the hotel operators would provide no benefit to its sponsors. On the contrary the greywater system could be a liability. In the opinion of the operators, the clientele of new, luxury accommodations would probably react negatively to such a system. For these reasons this particular conservation measure will not be included in the designs of the Copley Place hotels.

S-1-4

The issue of operable windows for ventilation has been studied by the developer and hotel operators. It is felt that operable windows are often misused, being open during the

summer and winter when the outside air adds to the air-conditioning and heating burden. For this reason, operable windows cause an energy loss unless very carefully controlled. In the Marriott Hotel and the retail/office area, therefore, outside windows will be fixed. Outside air will be provided mechanically, however, by the ventilation system that serves these facilities.

The operators of the luxury hotel, on the other hand, feel it is important to their clientele to be able to open windows. Therefore, they will have operable windows coupled with a complex monitoring system to detect when and where windows are left open in an unoccupied room. This will enable hotel personnel to close them and reduce energy losses.

The housing units for Copley Place will also be equipped with operable window units. These will enable each tenant to determine whether he will use outside air.

S-1-5

The design and fenestration of currently blank walls is the focus of the design review agreement between the BRA and the developer. At this stage, plans for these facades are not complete. The architects are in the process of doing studies to present to UIDC for review. When designs are further advanced, sketch plans will be submitted to the BRA for review.

A copy of the design review agreement is included as Appendix K to the Final EIR/EIS.

S-1-6

Mr. Robert K. Hunt has been designated as the UIDC official responsible for handling incoming complaints on construction and noise. The UIDC receptionist/operator will forward complaint calls and mail to him for action. Joe Brown or his designated representative, will record the date, time,

and author of each complaint received. Each such complaint will be investigated by the UIDC representative. Receipt of the complaint will be acknowledged by letter together with a brief explanation of the corrective action taken. Where corrective action is not possible the inability to remedy the situation will be described. A chronological file of the responses to complaints will be maintained at the UIDC offices. The file will be available for review by interested state and city agency representatives.

S-1-7

UIDC is willing to express its endorsement of the use of public transportation facilities by employees and patrons of the development. The developer will also assist with the dissemination of information describing the wide range of public transportation facilities that serve the site. UIDC does not feel, however, that it is appropriate for the developer to be assigned responsibility for establishing and monitoring a transportation control plan. Public agencies such as EOTC and MBTA should assume responsibility for programs to encourage use of public transportation.

S-2

It should be noted that UIDC and MBTA are currently engaged in a series of coordination meetings. The purpose of these meetings is to discuss and resolve the types of issues outlined in the MBTA letter. The general objective is to ensure cooperative efforts and coordinated construction schedules for the two major projects. Responses to the individual issues cited by the MBTA letter of October 30, 1980 follow.

S-2-1

The developer will be responsible for providing and maintaining a well-ventilated platform area for MBTA and Amtrak patrons since Copley Place will cover this previously open platform. In addition, the developer has made provisions in the design of Copley Place for a shaft-way and associated mechanical equipment to ventilate the platform area.

S-2-2

The Copley Place development provides emergency access to a safe area within 300 feet of the MBTA/Amtrak tunnel and B&A platform. Stairs to the Copley Place garage will be built to serve this purpose. Funding of these stairs is currently being discussed between the MBTA and the developer.

S-2-3

The Copley Place developer fully agrees that rail operations across the site must not be interrupted during construction of Copley Place. Through service will be maintained on at least one track at all times, as discussed with the MBTA. The means for providing the continuing service, at minimum cost to both parties, has been discussed at the coordination meetings.

S-2-4

The funding issues for the pedestrian underpass between Back Bay Station and Copley Place have been discussed between the MBTA and the developer of Copley Place. Negotiations for satisfactory limits for construction and funding responsibilities are near completion. It is likely that Copley Place will be responsible for funding all connection improvements within the bounds of its own site.

Note that unresolved design issues are to be covered according to the design review agreement between BRA and UIDC. This agreement is included as Appendix K to the Final EIR/EIS.

S-2-5

An agreement for the design treatment of the Southwest Corridor deck is currently being negotiated between the developer and the MBTA. It is expected that these issues will be resolved soon.

S-2-6

See response S-1-5.

S-2-7

See response S-1-1.

S-2-8

In order to accommodate the revised construction schedule for the Southwest Corridor project, the Copley Place developers have worked with the MBTA and the City to address potential impacts on Dartmouth Street. Agreements on construction scheduling affecting this location are forthcoming. Agreements

have already been reached on mutually beneficial staging of railroad track reconstruction under Copley Place. In addition, pedestrian access to Harcourt Street from the west side will be maintained at all times throughout construction.

S-2-9

The peak construction noise levels reported in the Copley Place EIR/EIS do not include constructon noise from the Southwest Corridor Project. According to the acoustical engineer* for the Southwest Corridor project, all equipment in use during construction in Boston must comply with City noise regulations. In addition, site-wide construction noise must comply with City regulations. The Boston Air Pollution Control Commission Regulation 3 states that the maximum construction noise at the property line of residential or institutional land-uses is 75 dBA (L_{10}). For business or recreational land-uses the maximum allowable construction noise level is 80 dBA (L_{10}). Impact devices are not governed by this regulation.

The Southwest Corridor project abuts a residential/ commercial area. However, it was conservatively assumed that the peak construction noise level (without impact devices) is 80 dBA. This value was corrected for distance and added to the peak construction noise levels (without impact devices) at each of the six receptors modeled for Copley Place. The following table shows the results of this analysis:

---

* Telephone conversation with Larry Whittick, Bolt, Beranek & Newman, December 10, 1980.

Receptor	Peak Copley Place Construction Noise*	Peak Southwest Corridor Construction Noise Contribution	Peak Noise Level	Noise Due to Southwest Corridor	Applicable City Noise Standard
1	75.6	45	75.6	0	75
2	70.7	42	70.7	0	80
3	74.9	68	75.7	0.8	80
4	75.6	80	81.3	5.7	75/80
5	77.9	53	77.9	0	75/80
6	78.2	46	78.2	0	80

It can be seen from this analysis that the potential effect of the Southwest Corridor constructon noise is localized to the immediate area of that project. At receptor 4, where the full 80 dBA peak noise level is present, Copley Place adds 1.3 dBA to the noise level, causing an exceedance of the BAPCC regulation 3 for business/recreational areas by 1.3 dBA. If Southwest Corridor construction noise is held at 75 dBA because of residential land use, the peak noise level at receptor 4 will be 78.3 dBA, 3.3 DBA over the City standard and 2.7 dBA above the noise level associated with Copley Place alone.

It should be noted that this analysis assumes that peak construction noise levels for the Southwest Corridor Project and Copley Place occur simultaneously at Receptor #4. This may not be the case. The peak Copley Place construction noise at Receptor #4 occurs during month #23, nearly two years after the start of construction. Construction of the section of the Southwest Corridor running from South Cove to Camden Street will take 2 years and 6 months. The peak noise levels will probably occur during the earlier stages of construction when excavation and foundation work will take place, and thus not overlap with peak Copley Place construction noise levels.

At none of the other five receptors does the construction noise increment from the Southwest Corridor project cause noise levels which were previously in compliance with the BAPCC regulations to exceed them.

---

* See Table 7.8-3 in Copley Place Final EIR/EIS.

S-3

The comments in the memo dated November 3, 1980 (to EOEA from the acting air pollution control section chief) have been forwarded to UIDC. Responses to these three comments are as follows:

S-3-1

The correction to the one hour ozone standard is acknowledged.

S-3-2

Bolt Beranek & Newman (BBN) tested several wind speeds during their physical modeling of dispersion from the Copley Place vent. Highest concentrations resulted at the 11.3 fps wind speed, therefore only the concentrations at this wind speed were reported. Dick Hayden and Len Fortier, of BBN, are available to discuss the lower pollutant concentrations observed at other wind speeds. They may be reached at 491-1850.

It should be noted that BBN studies of wind and dispersion are continuing. Additional work is being done in parallel with the detailed design for the ventilation system. Results of these continuing efforts will be available for review by DEQE in February or March.

S-3-3

Wind speed at pedestrian height may be either greater than or less than wind speed at vent height depending on local conditions. Normally winds are increased with height above ground level. The introduction of high-rise buildings may deflect higher winds at greater elevations down to ground level. Likewise winds may be accelerated at corners. For these reasons pedestrian level winds may vary considerably over the site area.

The required responses are provided by this document.

C-2

A stand-alone response for this comment letter is being prepared by the UIDC attorneys. This response will be made available to BRA and UIDC when it has been completed.

BOSTON PUBLIC LIBRARY
3 9999 06315 257 1